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modern plastics

JULY 1942

VOLUME 19 NUMBER 11

PHOTO, FIRESTONE TIRE & RUBBER CO.

AUGUST

Plastic upholstery fabric, brightly hued, flexible, tough, and with extraordinary tensile strength, is just one of the numerous applications woven from extruded vinylidene chloride fibers—one of the major achievements of the plastics industry during the past five years. A complete story on the development of vinylidene chloride fiber, its manufacture, uses, applications, advantages and potentialities is scheduled for the August issue, complete with photographs in color.

• GENERAL INTEREST

• TECHNICAL SECTION

• NEWS AND FEATURES

* With the U. S. Armed Forces

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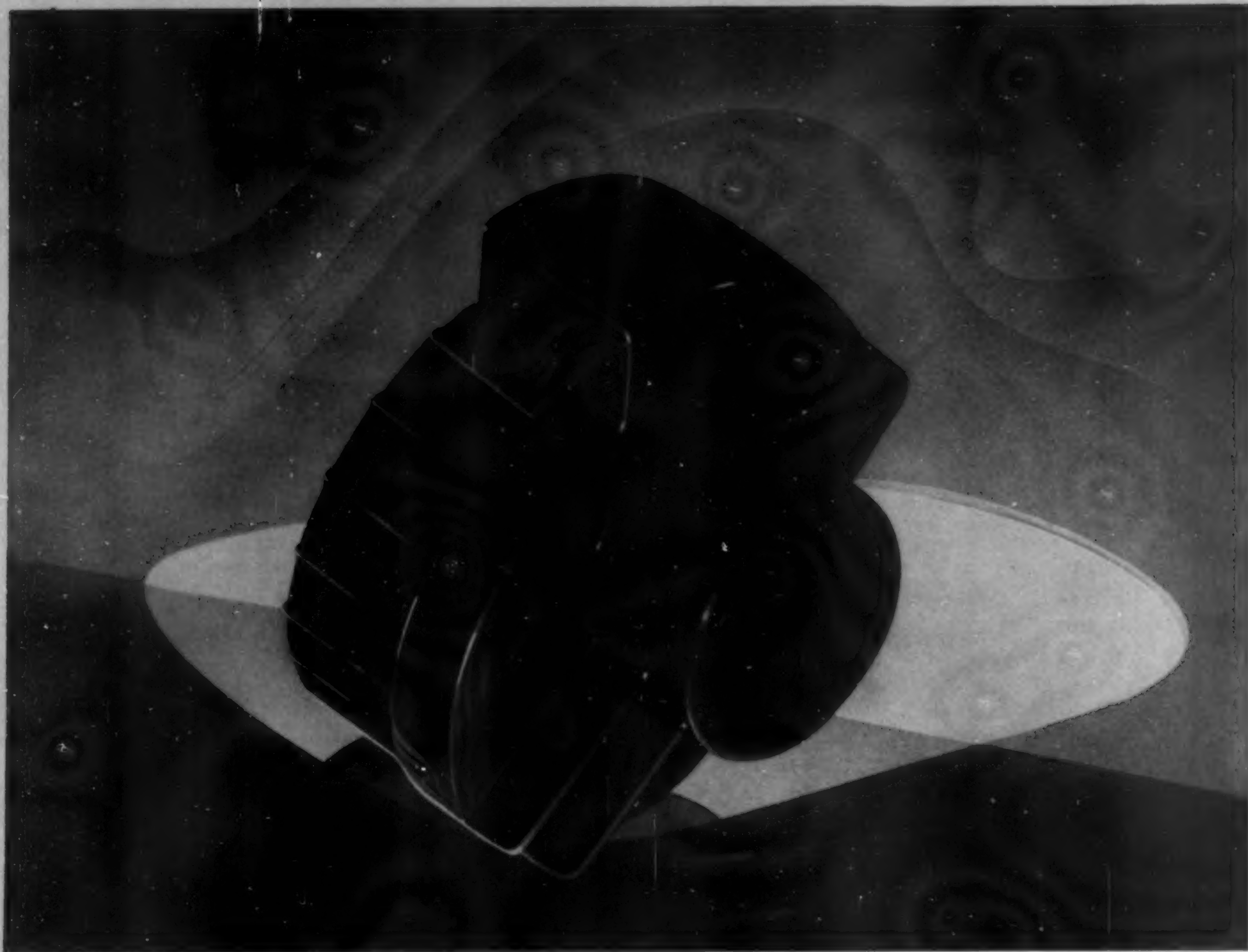

Here is something new for the "Son of Heaven"

SOMETHING new under the sun? *Yes, sir!*—lots of new products to speed up the drive against the Japs . . .

New parts like this (for the time being their use cannot be revealed) are made possible by the use of INSUROK Precision Plastics. This part is but one of many new war-designed products developed by *Richardson Plasticians.*

Because Laminated INSUROK can be machined to close tolerances with existing equipment, it facilitates sub-contracting—saves other critical materials for other important uses. Molded INSUROK, too, is serving with the air, land and sea forces because of its versatility and ability to meet the problems of the hour better, faster.

The Richardson Company, Melrose Park, Ill.; Lockland, Ohio; New Brunswick, N. J.; Indianapolis, Ind. Sales Offices: 75 West St., New York City; G. M. Building, Detroit.

INSUROK *and the experience of Richardson Plasticians are helping war products producers by:*

1. Increasing output per machine-hour.
2. Shortening time from blueprint to production.
3. Facilitating sub-contracting.
4. Saving other critical materials for other important jobs.
5. Providing greater latitude for designers.
6. Doing things that "can't be done."
7. Aiding in improved machine and product performance.

INSUROK

HOW "ZONES OF HEAT" END BURNING OF LONG, THIN MOLDINGS

• Zone Type Heat Control as shown above by transverse porting of mold provides graduation of the mold temperature from point of injection to the ends. This prevents chilling of the powder before it reaches the extremity of the cavity. Thus the material cylinder can be run at a lower temperature to eliminate burning and smearing and to produce excellent moldings such as the brush backs shown.

Du Pont Plastics Technicians help improve quality and increase length of injection moldings by development of Zone Type Heat Control.

YOU can now obtain unusually long thin molded parts, with plenty of strength and excellent appearance. It's done by a technique developed recently by the *Du Pont Technicians* with the cooperation and aid of molders.

Secret of this simple but effective method consists of porting the mold crosswise so that the mold temperature can be graduated from the point of injection to the ends. The heating of the mold in this manner permits the operation of the material cylinder at a lower temperature. As a result, long thin pieces can be molded without burning or smearing, thus giving a better quality piece, high yields, and insuring a molding with maximum physical characteristics. Parts not previously moldable are often achieved by this process.

Would you like details on this technique as applied to your future jobs? *Du Pont Plastics Technicians* will be glad to answer your questions. If you have other plastics problems, these experts will also help your engineers, designers, and technicians work them out to your advantage in your molding or fabricating plant if necessary. Put your plastics problems up to Du Pont. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, New Jersey.

DU PONT

REG. U.S. PAT. OFF.

PLASTICS

"Lucite" methyl methacrylate resin
"Plastacele" cellulose acetate plastic
"Pyralin" cellulose nitrate plastic

CELANESE CELLULOID CORPORATION

The first name in Cellulose Acetate Plastics for Aviation

AERO-QUALITY LUMARITH *Plastics*

(CELLULOSE ACETATE)

THE SUPER-TOUGH
TRANSPARENT PLASTIC
FOR
MOLDED PARTS
COCKPIT ENCLOSURES
WINDSHIELDS
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CELANESE CELLULOID CORPORATION, 180 MADISON AVE., NEW YORK CITY
A Division of Celanese Corporation of America
BRANCHES: CHICAGO, ST. LOUIS, DETROIT, SAN FRANCISCO, LOS ANGELES, WASHINGTON, D. C., LEOMINSTER, MONTREAL, TORONTO

A BETTERMENT . . .

Not a Substitute

Has there been a substitution for the "Good Old Days" Saturday night lavation?

No, the modern shower is a BETTERMENT!

Romantic as we may be, few, if any of us, would want to go back to the old tub bath in the stove-heated kitchen (often the only heated room in the house).

Neither will many of you designers and engineers want to go back to commonly used materials . . . now practically impossible to get . . . once you replace these materials, not with substitutes, but with materials designed to do a better job for you.

Getting the right NON-metallic material need not involve tedious delays for research and experiment. The CONTINENTAL-DIAMOND Laboratory has been doing experimental work of this nature for more than 27 years. Its files contain records of hundreds of difficult material problems solved. C-D is not limited to working with one or two NON-metallics, but manufactures FIVE distinctly different materials. One of these may be the answer to your "What Material?" problem.

Avoid substitute materials . . . so you won't have to go back to the kitchen-tub bath. . . . Write us today about your problems. . . . Send for Booklet GF-6.

Continental Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

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The war effort is worthy of the fullest support of every American. However, long hours of labor are not enough . . . financial support, too, is needed. You will help your Government and yourself if you purchase War Savings Stamps and Bonds on a *regular schedule.*

The nation's immediate needs for hydraulic presses and equipment still engage practically all of our efforts and facilities. However, R. D. Wood engineers will continue to cooperate to the fullest possible extent in the solution of your particular hydraulic press problems.

ESTABLISHED 1803

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PHILADELPHIA, PA.

HYDRAULIC PRESSES AND VALVES FOR EVERY PURPOSE

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Specifications—Resinox 6952 Black or Natural

PROPERTIES OF THE MOLDING COMPOUND:

Particle Size: Fibrous Filler

Apparent Density: 18.0 Grams per cc.

Bulk Factor: 6—7

Pourability: Non-Pouring

Preforming Characteristics: Hand Preform

Flow: Hard, Medium

PROPERTIES, MOLDED:

Specific Gravity: 1.35

Weight per cubic inch: 0.487 lbs.—22.1 Grams

Specific Volume: 20.5 cu. in. per lb.

Flexural Strength: 12,000—13,000 lbs. per sq. inch

Maximum Deflection: 0.095 in.

Tensile Strength: 6,000—7,000 lbs. per sq. inch

Impact Strength: 3.2—4.0 ft. lbs. energy to break
(notched rod) 6.4—8.0 ft. lbs. per in. of notch
40.0—50.0 ft. lbs. per in. square

Water Absorption: 1.4% by weight
(48 hrs., 25° C.)

Shrinkage: 0.003—0.005 inches per inch

These properties were determined using A.S.T.M. methods on standard sized test pieces molded under carefully controlled conditions and are, therefore, indicative of the properties of articles molded from this powder. However, such properties are materially affected by the size and shape of the piece and by variations in molding conditions and, therefore, no guarantee is implied that all articles molded from this powder will have the properties listed above.

DURITE

On Active Duty

● The entire organization of DURITE PLASTICS is dedicated to the fact that OUR NATION HAS A WAR TO WIN.

DURITE required for Tanks, Planes, Ships, Helmets, Tractors, Bayonet Scabbards, Guns, Ordnance and other Instruments of War MUST and SHALL have our wholehearted first attention.

DURITE for ESSENTIAL Civilian needs necessary to support the War effort will be made available in strict accord with the policies of our Government.

YOUR requirements of phenol-formaldehyde and phenol-furfural synthetic resins and compounds, or the new DURITE SYNTHETIC RUBBER compounds will receive immediate attention.

DURITE PLASTICS

REG. U. S. PATENT OFFICE

FRANKFORD STATION, P.O. PHILADELPHIA, PA.

MILLS PLASTIC
MILLS-PLASTIC
Fittings now available in the following sizes:
1/8"; 3/16"; 1/4"; 5/16"; 3/8"; 7/16"; 1/2"
INJECTION MOLDED PLASTICS
ELMER E. MILLS CORPORATION
Your signature on your letterhead brings you a copy of this catalog containing data and illustrations of molded thermoplastics . . . and MILLS-PLASTIC
Tubing and Fittings
MILLS-PLASTIC tubing and fittings are winning applause every day in overcoming obstacles in commercial and industrial uses. The unusual characteristics of this outstanding thermoplastic have enabled American industry to solve perplexing problems during the shortage of critical metals.
MILLS-PLASTIC tubing and fittings are adaptable under high working and bursting pressures. They have superior insulating qualities and are resistant to most chemicals. Tubing is flexible and easy to handle. It is flared with an ordinary screw-type flaring tool.
MILLS-PLASTIC fittings are available in flare type unions and half-unions, with molded threads and knurled faces for sure grip.
Consult our engineers regarding MILLS-PLASTIC possibilities. We shall be glad to assist you with your war production problems.
*Trademark of the Dow Chemical Co.
ELMER E. MILLS CORPORATION
Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and other Thermoplastic materials.
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PLASTICS PROPERTIES CHART

A chart outlining the physical, chemical, electrical properties of all plastic materials, can be purchased apart from the 1942 Plastics Catalog which is no longer available. Suitable for framing. The chart covers all thermoplastics and thermosetting materials, including the phenolics, ureas, acrylics, cellulose compounds, casein, nylon, shellac, lignin, cold molded, etc. Measures approx. 41" x 11½", printed on sturdy white paper.

Price: **$1.50**

SOLVENTS CHART

Available for separate purchase, the 1942 SOLVENTS CHART outlines types, formulas, molecular weights, specific gravities, melting points, boiling points, solubility in water, refractive indices, vapor pressures, common or trade names, manufacturers' names. Covers 229 solvents used in the plastics industry. Printed in black on buff stock. Two sections, each measuring approx. 41" by 11½" (total 82" x 11½").

Price, complete: **$1**

PLASTICIZERS CHART

Covers names, formulas, molecular weights, specific gravities, refractive indices, vapor pressures, etc., etc. (see above description of Solvents Chart) of 117 PLASTICIZERS used in the plastics industry. Includes manufacturers names and addresses. Up-to-date for 1942. Printed in black on blue stock. Measures approx. 43" by 11½".

Price: **$1**

ALL 3 CHARTS
PLASTICS
SOLVENTS
PLASTICIZERS
$3.00

SEND MONEY TO **CHARTS DIVISIONS**
PLASTICS CATALOGUE CORPORATION
122 EAST 42nd STREET • NEW YORK CITY

RIGHT NOW ...for Armament work you can use these Abrasive Finishing Machines

☆ DELTA Abrasive Belt Finishing Machine

When you are confronted with an urgent need for increased production in connection with the U. S. armament program—check into the possibilities of these Delta machines. Here is a 6" Abrasive Belt Finishing Machine that is heavy and husky enough to do any of the dozens of sanding, polishing and finishing operations to be found around the average shop, yet which is portable enough to be used just where it is needed. It has found wide acceptance for finning, finishing and surfacing metal and plastic parts. Every feature has been designed to eliminate disadvantages usually found in small belt polishing machines. The frame is heavy and substantial; the adjustments convenient and positive in action; attachments are quickly attached or removed; the machine may be used either vertically or horizontally, as required. It is completely guarded, and dust removal may be made efficiently. It is completely ball-bearing equipped with double-seal bearings, lubricated at the factory for life. There is no rubber covering required on the drums which eliminates one source of replacement expense.

No. 1402-C—Abrasive Belt Finishing Machine

☆ DELTA Abrasive Disk Finishing Machine

Designed to meet every requirement for accurate finishing, this Delta Abrasive Disk Finishing Machine is a high-grade tool for high grade work. From its completely machined, true-running 12" disk to its large surface table and the husky spindle of the belt-drive machine, carried on self-sealed ball bearings, it is designed for long life, low power consumption and accurate, dependable results.

Made on two models; one a direct-drive unit employing either a ½ H.P. or a ¾ H.P. ball-bearing motor. The disk in this unit fits directly onto the end of the motor shaft, making the machine completely self-contained. The other model is a belt-drive unit, which makes it possible to use any motor available, to use motors built for odd frequencies or voltages and to vary the speed to suit individual operations.

Dust collector available, making machine adaptable for use in locations where dust is objectionable.

No. 1426—Abrasive Disk Finishing Machine

Send for CATALOG giving full details and prices on Delta Abrasive Finishing Machines—and also showing full line of Delta drill presses, grinders, band saws, and other Delta low-cost machine tools.

DELTA MILWAUKEE

THE DELTA MFG. CO.
624-GE. Vienna Avenue, Milwaukee, Wis.

Please send me Catalog giving full details and prices on Delta Abrasive Finishing Machines, and your full line of low cost machine tools

Name ....

Address ....

City .... State ....

A Jap charging an American machine gun—or tank—or airplane—is the toughest inspector plenty of American industries will ever have to pass.

He's not going to give you a second chance. If you're not within your tolerances, it's curtains at the front line and back home. There's no margin for error in this war of machines.

We think of our new 'inspector' every time we make a mold or a molding. It keeps us on our toes.

This is a good time to watch your molder—now that the pressure is on. He may not be able to give you the molds nor the material you need. But if he *is* busy—he's got the goods, he's meeting tough specifications, he's delivering on time. If he's good enough to produce with the pressure on, he will bear *watching* now—and *using* later.

"A Ready Reference for Plastics" written for the layman, is now in a new edition. If you are a user, or a potential user of molded plastics, write us on your letterhead for a copy of this plain non-technical explanation of their uses and characteristics.

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO-PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-0991

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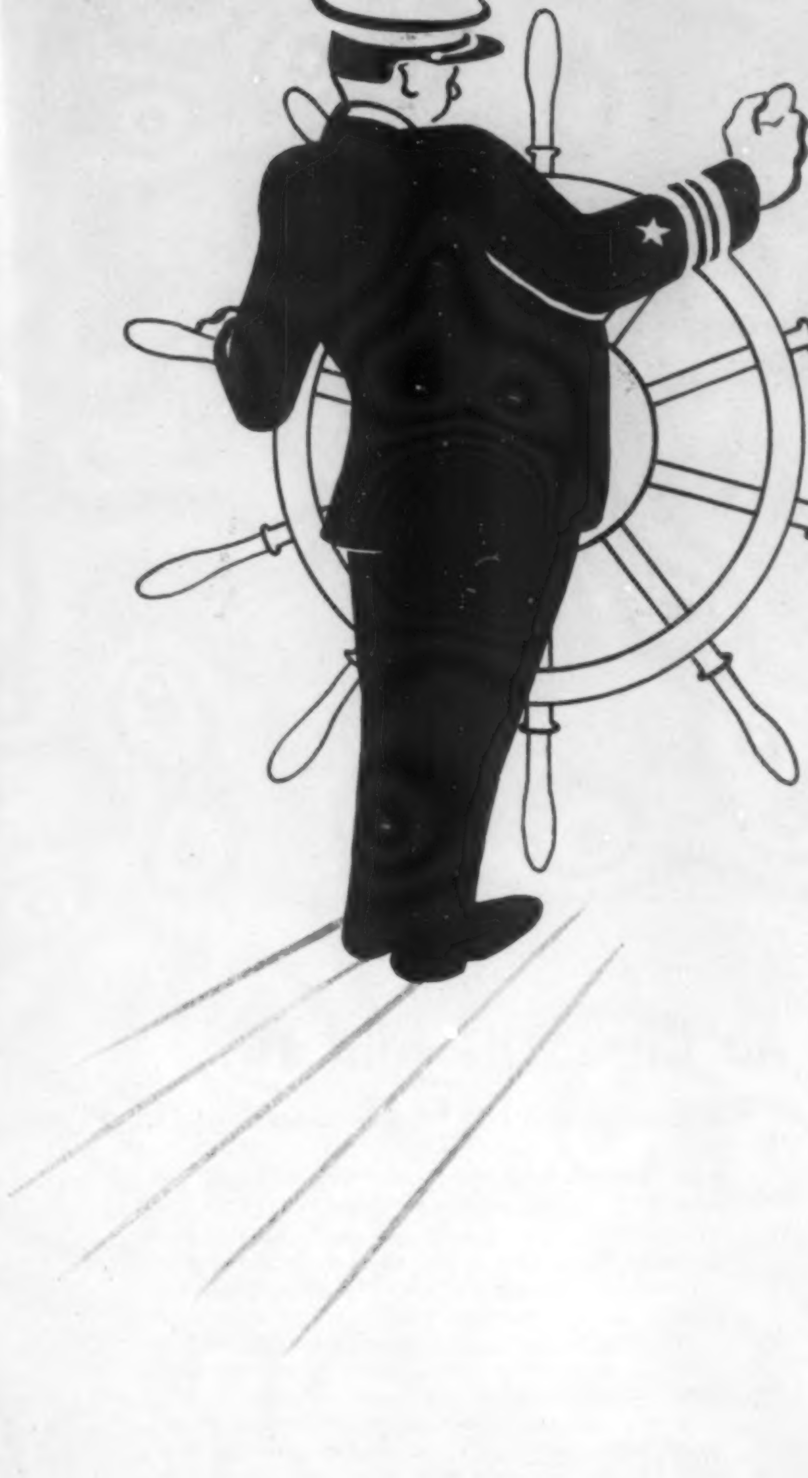


Change of Course

LESTER INJECTION MOLDING MACHINES

...a brief stop in Cincinnati to salute their former national distributor, Index Machinery Corp., for services well done . . . then *(Outward Bound).* Lester-Phoenix, Inc., pledges to maintain the same high standard of service.

Distributed by **LESTER-PHOENIX, *Inc.***
2711 Church Avenue • • Cleveland, Ohio

LESTER
INJECTION MOLDING MACHINES

YOU ARE LOOKING AT THE

BEGINNING OF A NEW INDUSTRY

(PLASTICS SQUEEZED OUT LIKE TOOTHPASTE)

Into cantonments and war housing, into big bombers and battlewagons, now goes a revolutionary development in cellulose acetate plastic . . . plastic squeezed out like toothpaste . . squeezed out six inches or sixty inches, ix feet or sixty feet . . . any profile, tube, rod r strip, and any length needed to do the job.

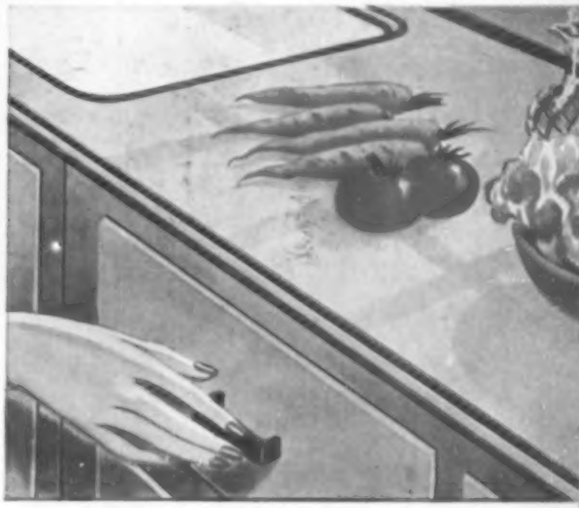
HAT ARE ITS PROPERTIES? It's tough, as all ellulose acetate plastics are tough. Scoffs at cuffing. Resists fruit acids, oils, gasoline, lcohol. Bends cold. Can't fade. Won't rot, ust, corrode, tarnish or chip. And it's easy o saw, file, nail, drill and cement.

HAT DOES IT DO IN WAR? Saves metal . . . ons of it. Replaces metal for stair-nosing, etal for edges and trim, metal for corners nd cap molds. Replaces metal in war-housing kitchens, in field medical tables, in electrical conduits for planes.

WHAT DOES IT POINT TO IN PEACE? Vast new vistas of architectural and interior design . . . new beauty for homes . . . new smartness for stores . . . new speed and economy for products. Hundreds of products undreamed of today will be made possible by this swift and thrifty process.

HOW DO YOU GET EXTRUDED PLASTICS? They are on the market now, in all parts of the country—extruded from powders made with a base of Hercules Cellulose Acetate Flake. Hercules does not make plastics . . . but by long years of research we have added much to the fabulous versatility of cellulose acetate. We have some interesting literature, which a note addressed to Department MP-7 will promptly bring you.

TRAMP, TRAMP, TRAMP—but the roughest wear of Service-shoes or war-work shoes can't faze tough extruded plastics. This is the profile for stair-nosing . . . others for *any* use: linoleum strip, cap section, edging, etc. Quickly put on; available now.



LOVELY TO LOOK AT, and such a practical replacement for war-housing kitchens. Cleans with soap and water, impervious to fruit juices, tough as only cellulose acetate plastic can be tough. A wide choice of colors, too, to delight the feminine eye.

All extruded plastic sections by R. D. Werner & Co., Inc., New York

HERCULES
CELLULOSE ACETATE

HERCULES POWDER COMPANY *Incorporated* · WILMINGTON, DELAWARE

CONSERVE CRITICAL MATERIALS—GET BETTER RESULTS

with "THE VICTORY STEEL"

Graph-Mo Steel will outwear competing oil-hardening tool steels and will machine at least 25% faster than competing steels.

Now add to this the saving in critical materials that is obtained from the use of Graph-Mo Steel and you will understand why it deserves to be called "The Victory Steel."

As revealed in this chart, Graph-Mo uses no Chrome, no Vanadium, no Tungsten, no Manganese, and only .25 Molybdenum.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO
Steel and Tube Division

PERCENTAGE OF ALLOYS IN OIL-HARDENING TOOL STEELS COMPETITIVE TO GRAPH-MO

Steel	Silicon	Molybdenum	Chromium	Vanadium	Tungsten	Manganese
A		.20				1.60
B				.20	1.25	
C			.50		.50	1.20
D			.70		.50	1.00
E			.50	.20	.50	1.20
F			.50	.25	.45/.75	1.20
G						1.50/1.80
H			.50	.15	.30	1.30
I			.70	.11	.50	1.30
J			1.60		.45	
K			1.20	.20		.90
L			.27	.25		1.70
M			.40	.10		1.30
N			.60		.40	1.20
O			.50		.50	1.05
P			.50		.50	1.15
Q			.50	.25		1.25
R			.50		.50	1.20
S			.20			1.65
T			.50		.50	1.20
Graph-Mo	.75/.85	.25				

SAVING IS FIGHTING

Graphitic Steels are in the front line of the conservation battle — will be doing a first rate constructive job as post-war competition — start using them now!

TIMKEN
TRADE MARK REG. U. S. PAT. OFF.
GRAPHITIC STEELS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

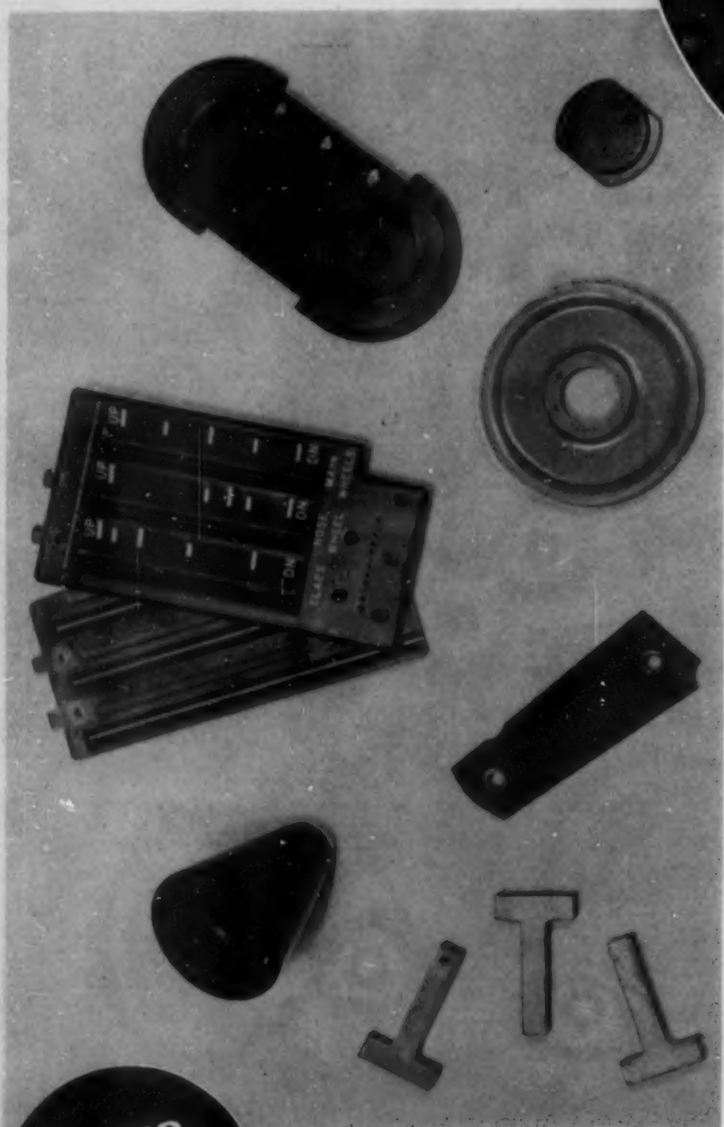
You Get ALL FIVE When You Use

1. High Impact Strength
2. Wide Range of Molding Shapes
3. Wide Range of Density
4. Combined Rigidity and Elasticity in the Same Piece
5. Distinctive Natural Texture

COLUMBIAN CO-RO-LITE

REG. U. S. PATENT OFFICE

Sisal Fillers



Now—get this light, tough sisal filler, impregnated with thermosetting resin, all ready for shaping, molding and setting in your own plant.

CO-RO-LITE is a resin-impregnated batting made from tough sisal cordage fibers, and consolidated into a firm sheet by a needling operation that drives the fiber tufts through the mass. By volume, its composition is one part of fiber to six parts of void space, providing ample air space for complete penetration of the resin powder.

Flash molds may be used, and the density and specific gravity of the raw sheets are adjusted to your specifications. Sheets and molded shapes are readily produced suitable for cams, gears, bobbin heads, bearings, tension and compression members, abrasive disc hubs, cabinets, scabbards and other items. A highly useful characteristic of Co-Ro-Lite enables the blending of both elasticity and rigidity in the same piece, as a rigid hub with a flexible outer periphery.

- **Write or wire for physical data and production recommendations.**

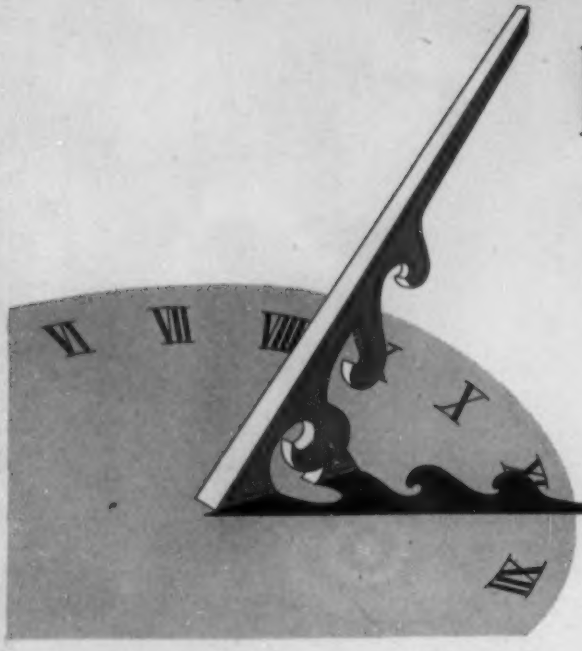
ALLIED PRODUCTS DIVISION

Patent No. 2,249,888
Other Patents Pending

COLUMBIAN ROPE COMPANY
400-10 Genesee St., Auburn, "The Cordage City," N. Y.


Watson-Stillman
Molding Machines
for all molding operations
If you are a manufacturer with priority ratings in the "A" classification, bring your problems to Watson-Stillman.
W-S engineers have worked with manufacturers-in-plastics right from the start—have a wealth of practical experience at their fingertips. And W-S regularly produces all kinds of molding machines—injection and compression—for molding all kinds of plastic materials—for large-scale production or diversified short runs.
Whether you require catalog material or engineering assistance, get in touch with Watson-Stillman now. The Watson-Stillman Co., Roselle, N. J.
Injection Molding Machines
Fully Automatic Compression Molding Machines
Semi-automatic Compression Molding Machines
Hand Molding Presses
Multiple Steam Platen Presses
2300
WATSON-
STILLMAN
Engineers and Manufacturers of Hydraulic Machinery and Equipment—Hydraulic Presses, Pumps and Jacks; Forged Steel Valves and Fittings

Now is the time for *Plastics!*



"There is a tide in the affairs of men which taken at the flood, leads on to fortune."

NOW IS THE TIME . . when all the natural and productive resources of our great nation are being converted to our united war effort.

NOW IS THE TIME . . when developments in the virile, growing Plastics Industry take on dual significance—first, as they contribute to the production of the sinews of war; second, as they herald revolutionary methods and materials of manufacture for the future.

NOW IS THE TIME . . to tell the Plastics Industry of the materials, equipment or services you have to sell. Molders, fabricators and manufacturers of plastic parts and products are meeting the ever-increasing demands of the present emergency. Techniques developed in the research laboratories of the Industry are available for active service on a wide variety of productive fronts.

NOW IS THE TIME . . even as it helps to win a war, that the Plastics Industry is preparing to shape the peace that will follow. Those of us who live intimately with this fastest-growing of American enterprises know that the same research and resources, processes and plants that today are diverted to war needs will be the foundation upon which will rise the multiple peace-time plastics production of tomorrow.

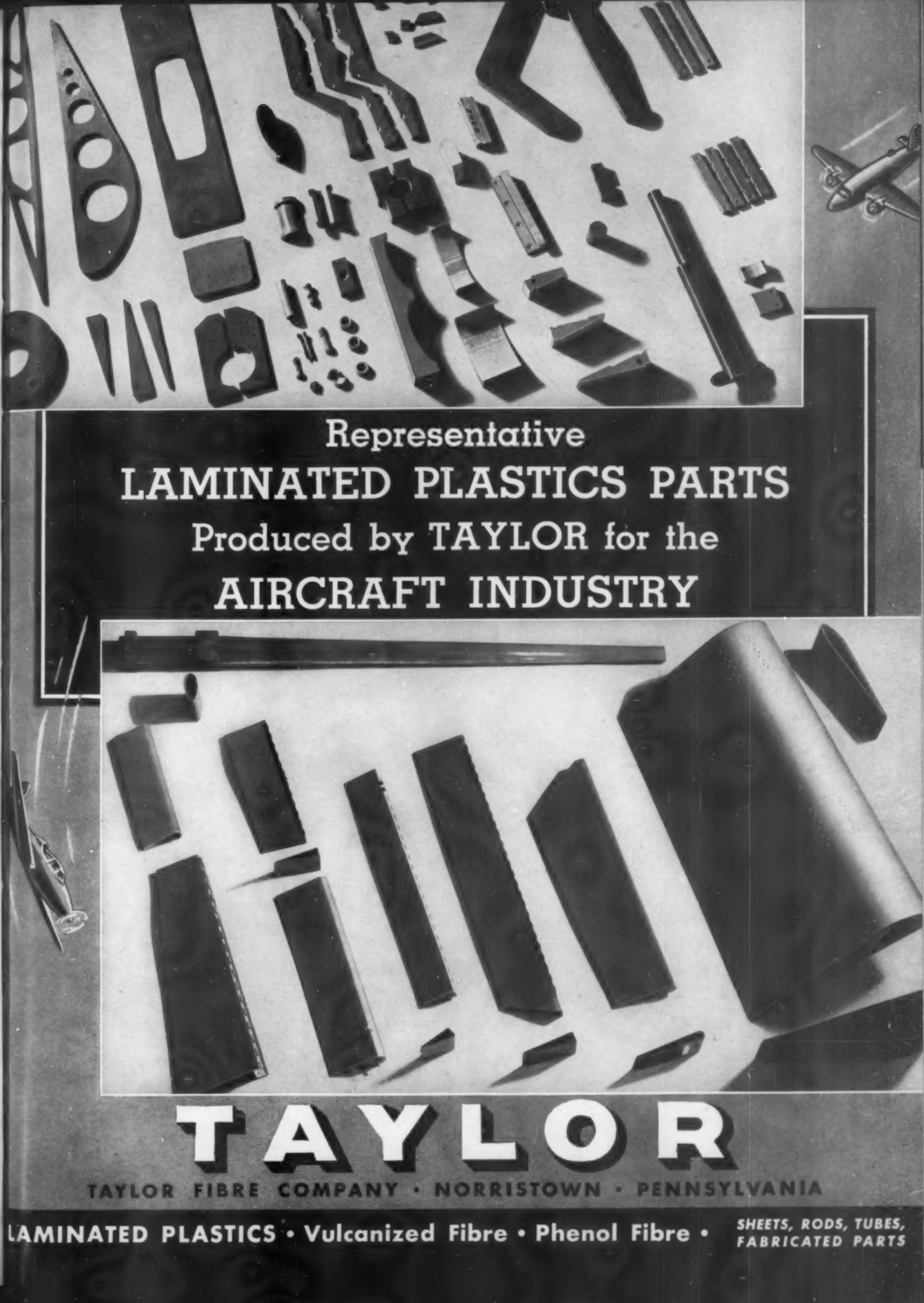
NOW IS THE TIME . . to secure the attention and active interest of responsible Plastics executives and engineers—the men who even now are planning and will eventually build the homes and automobiles and aircraft of the future—the men who are specifying and buying for the Industry today and who will look to the same established sources of supply for their even larger requirements of tomorrow.

NOW IS THE TIME . . for Plastics . . the time for an advertising schedule in MODERN PLASTICS Magazine—the *only* publication in the field—the meeting place of the minds of the men *you* want to reach!

modern plastics

America's Fastest Growing Publication *America's Fastest Growing Industry*

122 EAST 42nd STREET, NEW YORK, N. Y.


Representative
LAMINATED PLASTICS PARTS
Produced by TAYLOR for the
AIRCRAFT INDUSTRY
TAYLOR
TAYLOR FIBRE COMPANY · NORRISTOWN · PENNSYLVANIA
LAMINATED PLASTICS · Vulcanized Fibre · Phenol Fibre ·
SHEETS, RODS, TUBES, FABRICATED PARTS

MODERN PLASTICS
JULY 1942 VOLUME 19 NUMBER 11

ALL PHOTOS, COURTESY LOCKHEED AND VEGA AIRCRAFT CORPS.

The B-17 bomber takes off after a record production schedule involving three instead of the customary six months work, thanks to the plastic tooling program

Tooling for aircraft production

IN this fateful summer of the war, when it is recognized that a few days of delay may spell many years of conflict, every wind that blows in from the sea carries to American shores the cry of "Planes—send us more planes!"

In response to that desperate call, all over America hurrying hands are putting together the bombers and fighters, working anxiously against time and carefully, too, so that no scrap of precious metal will be wasted. In laboratories and research departments of war production plants, men are ceaselessly searching for new ways to save time, to conserve materials, to turn out the planes faster and faster.

Shortage of metals and shortage of time prompted a recent investigation into the possibility of using plastics for tooling in aircraft. As a result of this investigation, the Lockheed and Vega Aircraft Corporations in the past few months have begun producing tools made of plastics, both for drill jigs and for forming dies that will stand up to 8000 lb. per sq. in. under the hydropresses.[1]

This investigation was started by M. Basolo, foreman of the Lockheed Wood Shop, and has been carried forward along slightly different lines at Vega by Carl Hill, of Plastic Tool Development. The production research group assisted in later developments. It was Mr. Basolo's idea (which he describes in a patent disclosure) that drill jigs can be fabricated by securing the drill bushings to the master part, placing the part in a form and pouring a molding of material around it. When the material has solidified in conformity to the contour of the part, the bolts holding the bushings in position can be removed and the jig finished for use.

The reason for the initiation of this investigation is that the present method of drill jig construction, using wood with inserted metal bushings, has the following disadvantages:

1. The operations involved in creating a three-dimensional contour in wood are largely manual and hence slow and expensive.
2. Bushings must often be retained by steel nests or straps. This creates a layout problem which adds to the time and expense involved, and requires the extensive use of machine tools.
3. The wood is adversely affected by moisture and soluble lubricating oils, and may swell or shrink unless it receives surface treatment and periodic maintenance.

Requirements for a satisfactory thermoplastic material are that the material be of such a nature that it:

Can be cast at 225°–325° F. This will make it possible to cast the jig in an aluminum alloy part without damaging the latter.

Has a minimum softening point of 200° F. This will avoid danger of softening of the jig due to heat generated by drilling.

Is capable of control as to shrinkage during molding.

Can be reclaimed cheaply.

Can be finished on standard woodworking tools.

Has sufficient impact strength to withstand shop handling.

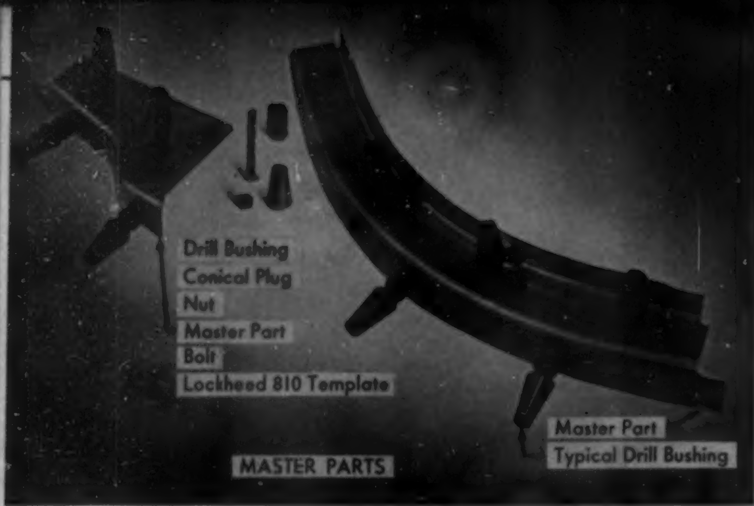
Does not exhibit brittleness at low temperatures or after aging.

Is resistant to lubricating oils and metallic chips formed in the drilling operation.

Of several materials studied, Lockheed accepted a phenol-acetone thermoplastic, while Vega at present is using an acid-setting phenol-formaldehyde thermosetting composition which contains 25 to 30 percent of ground walnut shell flour. Other

[1] See also "New Jobs for Cast Phenolics," MODERN PLASTICS, October 1941, p. 48 ff.

1



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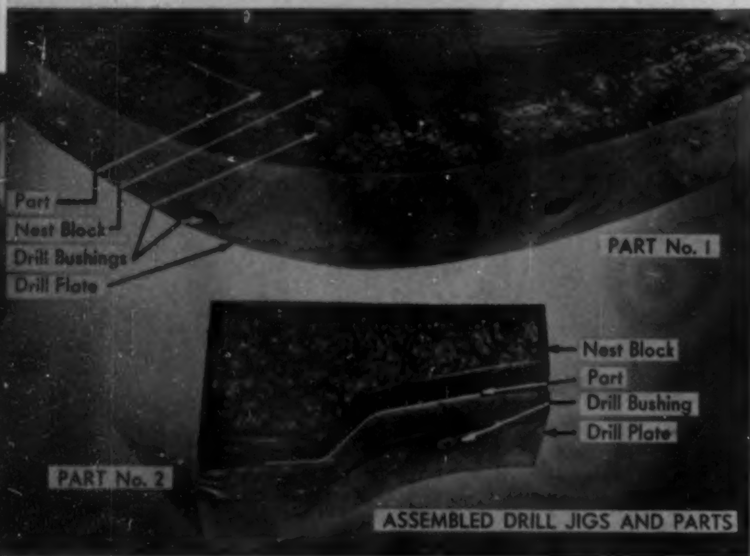

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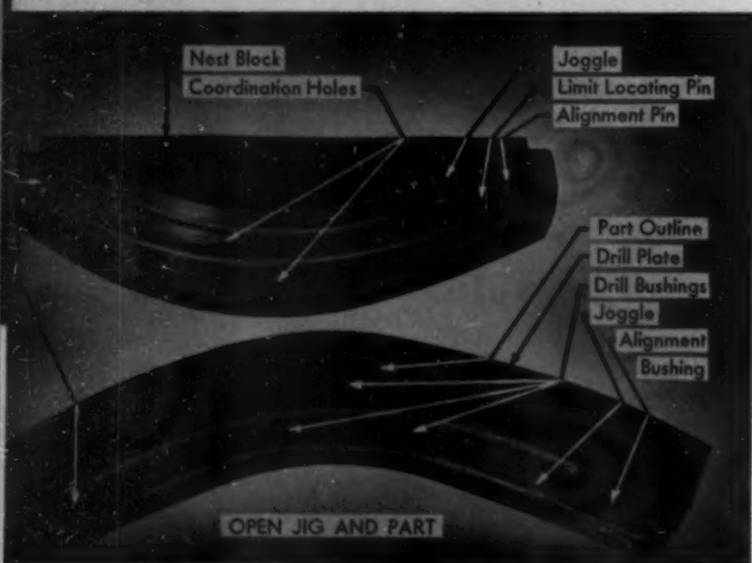

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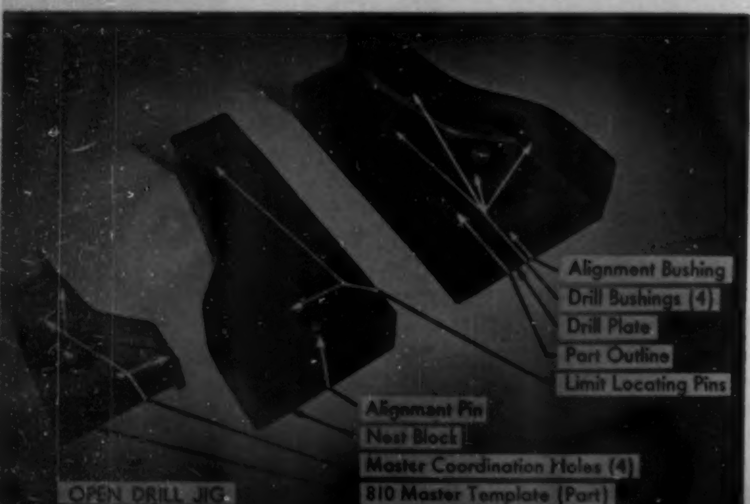

good fillers include woodflour, Masonite and scrap plastic. Plastics were accepted with reservations at first. Gradually, however, such misgivings were supplanted by enthusiasm. Plastics gained in popularity and plastic tools now dot the major and sub-assembly lines.

Investigation in the plastic tooling field has brought to light several desirable features of interest to both company and Government, whose motives are one and the same, namely, to produce airplanes more quickly and more efficiently. Among outstanding features are the following:

1. Plastics may be substituted for steel and dural in many cases.
2. Tools may be cast to a master part or plaster mold more quickly than by forming, milling or hand-fitting.
3. Duplicate tools may be fabricated at less cost than the original due to the fact that molds are saved.
4. Duplicate tools may be made economically and quickly for transportation to other plants.

The time factor—a very important item which designers, planners, tool makers and others involved in tooling must give prime consideration at this stage—has been one of the plastic exponent's greatest selling points. It is believed at Vega that the portion of their tooling program on the B-17F Flying Fortress which has been completed through the use of plastics, involving three months' work, would have required five to six months if wood, dural and steel had been used. This represented a saving of vital time, since many of the jobs performed during the three-month period have been those which threatened to interfere with production schedules if not done quickly. Such results were possible because plastics lend themselves readily to casting to a master part.

This brings up another important feature. If templates or engineering data are not available, but a master part is available, then not only is time saved in making the actual tool, but there is eliminated the time necessary to obtain this information and to make the templates. In this case, the master part is used by building up the sides to allow for proper thickness of plastic and casting directly to the part. An exact reproduction of the contoured part is obtained by this method, thus eliminating machining, fitting to templates, etc. Techniques have been worked out to allow for part thickness when casting to a part; to allow for part tolerances by making the casting oversize, even when casting to a master part.

"Vega has conducted experiments and research in both the thermosetting and thermoplastic fields," states Carl Hill, of the Plastic Tool Research Section, in a recent report. "However, we will discuss the thermosetting, cast materials at this time. We have found that plastics are applicable to drill jigs [Fig. 10], formed router blocks, shaper blocks, saw jigs, checking fixtures, hydro form blocks [Fig. 12], dies, punch jigs, forming dies for acrylics [Fig. 11]; in other words, most jigs that involve contours. We have not found plastics to have any particular advantage on jigs where no contour is involved except from the standpoint of conserving vital materials.

1—***Liquid phenol acetone thermoplastic poured hot and cooled in the mold is method Lockheed uses to form aircraft tools and forming dies. Master parts for molded drill jig shown here. Note master coordination holes in template (left) and drill bushings after removal of cone-like plugs (right).*** **2**—***To complete jig, part is clamped between drill plate and nest block. Coordination holes are drilled, aligned with drill plate.*** **(3)**—***Jig is then unclamped.*** **3,4**—***Molded drill jigs, open and closed***

"In cast phenolic drill jig plates we are unable to cast the bushings directly in the drill plate. Locating the bushings, however, is accomplished quickly and efficiently by casting cerromatrix around the bushings which, in turn, are located to the master part or template by means of pins, oversize holes having been drilled in the plastic plate to accommodate the bushing and cerromatrix. These bushings are especially designed for thermoplastics and are of sufficient wall thickness to eliminate the possibility of their becoming overheated and losing their location.

"These bushings, incidentally, are more quickly manufactured because of the fact that only the inside diameter is vital. When the quantity of drill bushings used throughout the nation is taken into consideration, the man hours and machine hours that could be saved would amount to a startling figure. On one drill jig that we made there was a saving of $70.11 in the cost of bushings alone.

"Router blocks, shaper blocks and saw jigs made of plastics have two particular points in their favor. One is that they can be cast to a contour. The other is their natural resistance to the soluble oils used in the fabrication of parts. They do not warp or lose tolerance because of moisture absorption."

With the addition of the acid catalyst to the base resin, Vega is now able to set up and finish the average work in plastics in eight hours—work that may take from three days to two weeks by former methods.

For hydropress production tools, where a minimum of $1^1/_2$-in. draw can be maintained, applying external beads as stiffeners around lightning holes in flat work, the application of plastic tooling can help speed up production by using two or more duplicate tools which are cheap to manufacture and light to handle. The development work can be done with a wood form block and a plaster split mold can be made to this wood form block. In this manner, duplicate tools may be cast out of plastics, the plaster split mold always being saved in event of breakdowns due to rough usage in production.

Plastic will not move under pressure, and thus definite mold lines will always be maintained, as long as the pressure does not exceed about 8000 lb. per sq. in. to form any kind of material. The only impact requirements of plastics are that the material withstand dropping to the concrete floor and normal impact incurred in loading and unloading the jig or hydropress.

The tests of early compounds of the phenol-acetone thermoplastic resins at Lockheed showed very favorable results, and immediate application appeared feasible at first. However, it was demonstrated that the material possessed definite aging properties which were not desirable. The aging appeared to be due to the crystallization of the excess maracaibo wax which had been added to make the material more inert to soluble oil. This crystallization precipitated wax fracture planes. Characteristic needle-like crystals consistently occurred in the fracture plane, being symmetrically oriented

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5—Acid-setting phenol formaldehyde compound, poured cold and baked, is the method used by Vega for the manufacture of its aircraft tools. Here resin is being drawn from the barrel containers into the mixing vat which is mounted on a scale. 6—A standard dough mixer receives the catalyst which must be thoroughly mixed with the resin to avoid spots in the final casting. 7—After the catalyst is well mixed with the resin, ground walnut shell flour is poured into mixer for filler, and liquid transformed into a solid mass

8

9

in the direction of shear. The problem apparently has been solved by removing the major portion of the maracaibo wax. Inertness to oil has not been adversely affected by decreasing the wax content from 3 percent to 0.5 percent.

Having overcome this first difficulty, the problem was resolved into one of compromising between softening temperature and impact strength. Plastic materials having good impact strength tend to have too low a softening point. However, considerable variation can be obtained by varying the type and quantity of plasticizer used. The first compounds treated with liquid plasticizers had relatively low softening points, so that on very hot days clamping devices on a drill jig made of these would sink into the surface.

A chemical company then succeeded in developing a solid plasticizer which raised the softening point from 150° F. to approximately 250° F. The resulting material had excellent casting characteristics, high softening point, etc., but was unsatisfactory in practice because of brittleness. Hence, a compromise was reached by adopting a part liquid, part solid plasticizer, which resulted in a resin composition with the desired properties.

The development of this project has included not only the determination of a suitable plastic material, but also the perfection of a technique for fabricating the jig using such a material. This technique has been worked out in some detail and is fully described below, both for Lockheed and for Vega.

The type of part to which this process is best suited is an open contour, with or without joggles. The equipment required for making the plastic drill jigs of the material used by Lockheed consists of a jacketed kettle equipped with a device for agitating the mixture. The agitating device should not merely consist of a paddle arrangement but should be of such nature that it will continuously scrape the material from the side and bottom of the kettle. This is referred to in the trade as a "full scraper type agitator." The jacket on the kettle is for the purpose of containing a liquid bath which may be heated to maintain the desired temperature throughout the kettle. Without such a bath surrounding the kettle, mainte-

8—*A converted dough mixer is used to pour the plastic resin into a plaster mold.* **9**—*Compressed air is enlisted as an aid to separate the plastic die from the plaster mold.* **10**—*Tool "baking" shop—resin mixer in background. Worker (right foreground) inspects plastic die as it comes from oven*

10

11

11—*Aircraft forming dies are some of the largest phenolic castings ever produced. Vital factors in turning out tools in record time, these dies are reported to have been made at fraction of previous cost*

nance of uniform temperature is extremely difficult. The only suitable alternative would be the use of an electric heating element wrapped around the kettle.

At Vega, the thermosetting composition is mixed in an ordinary baker's bread mixer and then baked at 175° F. in a cookie oven (Figs. 5–10).

Lockheed phenol-acetone thermoplastic technique

Molded drill jigs are fabricated from Lockheed master part templates. The template contains master coordination holes (see Fig. 1). Drill bushings are bolted through the master coordination holes to the template. This assembly is then placed in a retaining form and the plastic material is cast over the part and around the drill bushings. Shrink is controlled by having the retaining form extend above the master part. Hence when the hot plastic first comes in contact with the cold part, it solidifies rather rapidly, freezing to the contour. As the remaining plastic mass progressively solidifies, plastic is supplied from the reservoir created by the retainer, terminating in a sunken surface on top.

When the cast is cool, the retaining forms are removed and the concave free surface of the block is finished on the joiner until flat. Here the cone-like plugs (Fig. 1) are first removed, making the position of the drill bushings visible. A certain amount of care must be exercised at this point to prevent the joiner blades from striking the drill bushings. In practice, the plastic is cut to within $^1/_4$ to $^3/_{16}$ in. of the external drill bushing face and the hole to the drill bushing is champfered as a finishing operation. Thermoplastic parts may not be sandpapered, as frictional heat causes gumming. However, a spoke shave or floor scraper will give a well-finished surface.

To complete the jig, the part is placed between the drill plate and the nest block (see Fig. 2) and the assembly clamped together. The alignment of the coordination holes in the part and the drill plate is checked by inserting the proper-sized drill rod through the drill bushing and into the coordination holes of the part. This having been verified, the $^3/_8$-in. holes are drilled through the ends of the assembled jig to accommodate the alignment bushing (see Fig. 3 for position of alignment bushings). The jig is then unclamped. The alignment bushings, which are serrated about their outer circumference, hold securely when driven into place. The alignment pins are then driven into the alignment bushings in the drill plate and held in place by heating a small amount of the plastic and flowing it into holes on the back of the drill plate. Limit pins are driven into the drill plate at the ends of the master part, or may be placed through the part if it contains pin holes used to locate the part during forming.

In jigs of phenol-acetone resin, the position of drill bushings may be altered by "drifting." This is accomplished by inserting a torch-heated drill rod in the bushing, allowing the heat to diffuse momentarily, then applying a force in the desired direction of movement. This will facilitate any alterations required by inspection.

Figures 3 and 4 illustrate typical molded drill jigs in open and closed positions.

If the part from which the drill jig is cast is extremely large, an alternative method of affixing the drill bushings is available. First the drill plate and nest block are cast as outlined above, except that the drill bushings *are not* bolted to the master part. When the drill plate has been planed to the lengths of the drill bushings, the master part is nested and holes backdrilled through the template and drill plate. Using the pilot holes, enlarged to a diameter of 1 in., affix the drill bushings to the master part, nest into the drill plate, clamp and cast sufficient plastic around the bushings to bond them to the drill plate. Disassemble the bushings from the master part and finish as described in the preceding method.

After inspection, the drill jig is ready for service and, given proper treatment, should prove satisfactory for innumerable parts. If the jig becomes damaged or obsolete, it may be returned to the plastic shop where facilties are available to salvage the plastic material and the metallic bushings, alignment accessories, etc.

Vega phenol-formaldehyde thermosetting technique

The Tool Research and Development Division of Vega, in working out a technique for the application of plastics in their tool shop, reached several practical conclusions:

(*Please turn to page 104*)

ALL PHOTOS COURTESY TENNESSEE EASTMAN CORP.

1

The people's pump

IT is no longer mere rhetoric to say that there are no civilians in this war. In England, in France, in Holland, in Greece and everywhere the enemy has struck, that fact has been demonstrated again and again with the terrifying reality of bursting bombs and crackling flames. There are no boundary lines limiting the front line of battle—it may begin on your neighbor's lawn and extend to his child's nursery. And the United States today has the responsibility not only of arming her soldiers in uniform, but of providing suitable weapons for the "non-combatant" householder. One of the most important of such weapons for civilian use under present war conditions is the stirrup pump, a small, innocuous-looking mechanism, reminiscent in structure of the bicycle or automobile tire pump. In the event of bombing of United States civilians, however, this very stirrup pump may be the most effective means of controlling and rendering harmless the fires started by incendiary bombs.

The fact that several millions of these portable pumps (to be used in conjunction with the ordinary household pail or bucket) will be needed throughout the country made it at once apparent that stirrup pumps currently on the market would be out of the question. In the first place, the copper alloys of which they were made are no longer obtainable in requisite quantities; and, in the second, their cost ($8 to $23) was prohibitive.

Patently the citizen's pump must be relatively inexpensive; and $5 was set as the outside retail cost limit, the hose included. It should be made of materials that are non-strategic, so simply designed that it can be manufactured without difficulty by a number of concerns, both large and small. In character it should be durable, rust-resistant, proof against clogging, and contrived to deliver water either in a steady stream or in a fine spray.

Detailed specifications for this piece of equipment have recently been formulated by the War Production Board and approved by the Office of Civilian Defense. They provide for an inexpensive, lightweight, manually operated unit of the single suction, double discharge type. When the pump is in operation, pressure and capacity characteristics must be sufficient to develop a stream through a $^{1}/_{8}$-in. opening with a horizontal range of at least 30 ft., using 30 ft. of $^{3}/_{8}$-in. inside diameter hose and nozzle as specified. The pump, which will stand approximately 26 in. high, will have a barrel and plunger of welded steel tubing, a handle of ferrous metal and wood, stirrup and foot rest of formed steel, welded steel tubing or steel stampings. It will be sturdy enough to stand a great

deal of hard usage, and sufficiently corrosion-resistant to be stored over long periods without deterioration. It will be capable of building up a pressure of 200 lb. against a closed discharge.

The design, as conceived by the industrial engineers of the War Production Board, provides for at least seven, and possibly eight or nine plastic parts as follows:

- Valve seat and cage of the bottom intake (or suction) valve.
- Plunger follower (or sealer).
- Two gland (or packing) rings, which seal the plunger in the barrel.
- Spray nozzle, in two parts.
- Strainer (optional).
- Hose (materials now being tested).

Pumps incorporating the plastic parts specified are already in production.

Cellulose acetate butyrate, which is used for all of these parts except the hose, proved in tests to be eminently satisfactory. The material will not corrode, is practically unbreakable, possesses good dimensional stability and low water absorption, and can be economically produced in volume. In addition, use of the plastic releases large amounts of brass and other non-corrosive metals for war matériel.

The molded plastic bottom intake valve, which contains a small glass marble functioning as a poppet, is designed in two parts, the seat and the cage, which are acetoned together. The lower section, incorporating the valve seat, is approximately $1\,^{3}/_{32}$ in. outside diameter, tapering down to $1\,^{1}/_{16}$ in. outside diameter at the shoulder, and is $^{3}/_{8}$ in. high. The $^{1}/_{8}$-in. high shoulder provided for the acetoned joint has an outside diameter of 1 inch. On the interior of this valve seat are six triangular ribs which not only give it greater strength but also serve as guides for seating the marble poppet. The cage is $1\,^{1}/_{16}$ in. outside diameter at the bottom, where it joins the seat, and carries the same taper as the seat. In addition to a shoulder for acetoning, it has two narrow bars crossing at right angles to form a top which, while holding in the poppet, offers little obstruction to the flow of water.

When these two sections are acetoned together they form an assembled part $^{3}/_{4}$ in. high which tapers from $1\,^{3}/_{32}$ in. to $1\,^{1}/_{32}$ in. in outside diameter. This intake valve assembly is pressed into the bottom of the similarly tapered welded steel tube barrel and locked firmly in place by two metal ears punched from the wall of the barrel in such a way that the openings provide an inlet for the water when the pump barrel rests on the bottom of the bucket.

Optional for plastic is the intake strainer, a perforated disk 1 in. in diameter and specified for 28-gage steel sheet. If plastic is used, this piece will be stamped from sheet stock $^{1}/_{32}$ in. thick.

The plastic plunger follower, or sealer, incorporating the other poppet seat, is molded in one piece to eliminate the necessity for a washer of leather or similar material. The sealing portion of the follower is $^{3}/_{8}$ in. wide with a constant outside diameter of slightly over 1 in. and a $^{3}/_{32}$-in. wall section. The top part of the follower, $^{7}/_{16}$ in. high, is threaded from the shoulder and has an outside diameter of approximately $^{31}/_{32}$ in. including the threads. On the inside of the sealing portion of the follower are four short, heavy ribs, positioned in pairs to accommodate the spanner type of wrench which will screw the piece tightly into the welded metal plunger. (*Please turn to page 118*)

1—An embattled citizen sprays an incendiary bomb in his attic, shielding his face from glare, heat and sparks, while his wife pumps water from household pails. 2—Plastic pump parts, left to right: Plunger follower, valve seat and cage, nozzle, accessory cap, gland rings. 3—Pressure on nozzle spring produces steady stream of water

3

2

Right for rain

PHOTO, COURTESY CARBIDE & CARBON CHEMICALS CORP.

1

THE teeming torrents of the untamed tropics, the biting of arctic snows, the damp congealing London fog, or the friendly rains of the temperate climes—utterly uncontrollable, a ruthless Nature provides a new setting for every theater of war, and it's up to the Army Quartermaster Corps to furnish the costumes! Clothing an Army of about 3 million men in garments adaptable to any conceivable weather or climatic condition—and some meteorological phenomena still unrecorded—has been and still is a tremendous undertaking. Although supplying adequate storm apparel was just one of the QMC's many jobs, the goodlooking G-I raincoat represents the culmination of several years' research.

Early in 1940, long before a rubber shortage was generally recognized as an imminent possibility, the Philadelphia Depot of the Army Quartermaster Corps started development work on an improved raincoat for enlisted men. Materials commonly used in manufacturing rainproof garments for military personnel were made of rubberized or oil-treated fabrics.

There were several definite limitations in the serviceability of these two materials. Oil-treated coating cracked readily at low temperatures, became sticky in hot weather, was affected by sunlight. Rubberized garments were heavy and of course had an unpleasant odor when wet. In addition, rubberized coats showed a decided tendency to deteriorate in storage and under extreme weather conditions, owing to oxidation.

Attempting to improve raincoat durability and service, the QMC turned to synthetic coatings and found a suitable

1—Army raincoat of plastic-coated cloth replaces the old rubberized or oiled garment. 2—In calendering, pigmented and plasticized powdered resin is blended in mixing equipment. 3—Ingredients are then milled on hot stainless steel rolls. 4—Solution is calendered to cloth on hot rolls under pressure. 5—In spread-coating, pigmented resin dispersion is strained into drums. 6, 7—Viscous coating is spread on cloth by means of spreader knife, and then coated cloth is dried in oven (at back) and wound up on roll

PHOTOS, COURTESY B. F. GOODRICH CO.

2

3

plastic with the inherent properties required. Intensive collaboration between QMC engineers on the one hand, and plastic material suppliers, cloth converters, fabric producers and raincoat manufacturers on the other, resulted in an entirely new raincoat fabric which took advantage of the unique characteristics of properly plasticized and pigmented vinyl resins as a replacement for the rubber or oil coats. Not only has the new garment proved superior, but recent restrictions on rubber have thoroughly justified the research and subsequent changeover.

Two members of the vinyl resin family that are employed are a plasticized polyvinyl chloride and a high molecular weight vinyl copolymer resin. Outstanding characteristics of the resins are: Superior aging properties, even under direct sunlight; freedom from odor or taste; resistance to extreme temperatures and non-flammability. Since the plasticizers used in forming the coatings are flammable, the plastic-coated fabric will burn, but will not flare up like nitrocellulose.

The processed fabric product is pliable, dry to the touch, has good resistance to hydrostatic pressure, is extremely light in weight and thoroughly weatherproof. It meets temperatures tests of plus 180° F. without becoming tacky, and of 0° F. without cracking. (Complete details of these tests and of the other stringent tests and requirements will be found in the partial list of specifications for the synthetic resin-coated raincoat, appearing on pages 43 and 110 of this issue.)

Coating methods

The coated fabric is produced by spreader-coating with a dispersion of the vinyl resin composition in suitable solvents or by calendering a thin film of the compound to the cotton fabric base. Major considerations in following either method are the proper formulation of resin plasticizer and pigment. When the solution coating method is used, provision for recovery of solvent is usually a cardinal economic principle.

Calendering: This method is similar to that used in rubberizing fabrics but higher temperatures and more accurate control are required throughout the various operations. Basically, the powdered resin (vinyl copolymer or polyvinyl chloride), plasticizers and pigments are thoroughly mixed in typical mixing equipment (Fig. 2), as is any other plastic. Then the ingredients are milled on hot rolls (Fig. 3). When the resulting substance is about the consistency of a hot gummy mass, it is put on hot rolls and the cloth and raw mix are simultaneously passed through the rolls under pressure

PHOTOS, STANLEY CHEMICAL CO. AND CAMBRIDGE RUBBER CO.

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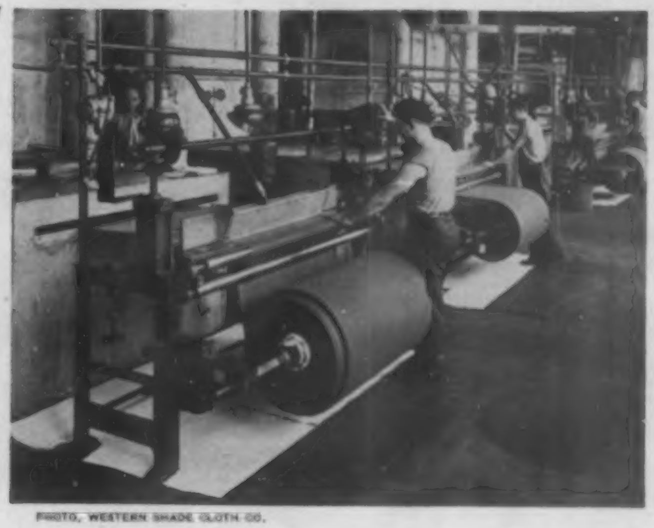

PHOTO, WESTERN SHADE CLOTH CO.

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PHOTOS, COURTESY B. F. GOODRICH CO.

8—From first to last Army raincoats are produced with skill and care, and every foot of plastic-coated fabric is carefully inspected before manufacture is begun, with detailed specifications serving as a guide. Here, the cutter guides his machine along the outlined pattern markings to obtain the various parts of the garment. 9—Several types of construction are used. After cutting, large comfortable pockets are applied to cemented areas on coat front. 10—Smooth, flat seams are assured by careful rolling of all seamed sections on front of garment

(Fig. 4). Thus the plasticized resin compound is calendered right onto the cloth fibers. Occasionally a prime coating is put on the material to impregnate the surface of the cloth fibers and thereby insure better adhesion.

Spreader-coating: This technique applies the same plastic mixture in solution form. Either the pigment and plasticizers are dispersed in a ball mill or mixer, or the pigment dispersion is added directly to the resin solution. The pigmented resin lacquer is then strained into drums (Fig. 5) prior to being put on rollers in the spreading machine. The viscous solution is spread on the cloth by means of a spreader knife (Figs. 6–7). Coated cloth passes through an oven and is then wound up on rollers. Usually several coatings are applied in order to obtain weather resistance.

Since the vinyl resins used are of high molecular weight and therefore not easily soluble, the coating solution may be heated in order to permit the use of more solids and make possible the use of the least expensive solvent available. The solution coating method requires a lower volume of resin. It makes use of less plastic to waterproof the fabric and provides a more continuous adhesion. The calendering method does not require expensive solvents and is somewhat simpler because no drying is necessary. In both, the prime essential is to achieve the proper degree of plasticity in order to secure flexibility at low temperatures and prevent tackiness at very high temperatures.

Raincoat fabrication and design

Every foot of plastic-coated fabric is carefully inspected both on the rollers and on flat tables before being made into raincoats.

The design approved for the raincoat pictured in Fig. 1 is a 5-button, straight front raincoat with two vertical open-through pockets. Collar is plain with a detachable rectangular collar tab. There is an outside ventilated yoke, double inside storm fly and rectangular sleeve tab. The fabric side of the material is on the outside of the coat.

The construction requirements are broad since the three classes of raincoats are differentiated on this basis, in order to bring in more contractors. Classes are: "A," stitched and sealed construction; "B," stitched, cemented and strapped construction; and "C," cemented construction. The distinction between "sealing" and "cementing" may be explained thus: sealing is a heat-sealing operation which heats the coating so that it softens and fuses together. Cementing requires an adhesive of good strength and flexibility which is compatible with the vinyl coating. Copolymer vinyl resin or synthetic rubber are customarily used, dispersed in a solvent which softens the vinyl coating. More detailed construction specifications are on page 43. Patterns are standard and the requirements for every detail of cutting, stitching, construction, assembly and packing are included in the specifications along with the methods of testing and sampling.

Naturally, the most important requirement of the raincoat is that it be completely waterproof. The finished raincoat must also be flexible, abrasion-resistant and "show little or no evidence of marring when folded or creased." The plastic coated material meets these conditions and, in addition, the resin coating is free from objectionable odors, eliminates the danger of subsequent stickiness and does not weaken the fabric.

By the use of these vinyl formulations, the QMC and plastic suppliers have developed a processed fabric coat that will stand for a lot of abuse when its wearer has to take it from the weather while he is handing it out to the enemy.

RAINCOAT, SYNTHETIC RESIN COATED, O. D.

The following are extracts from the Quartermaster Corps tentative specifications for an Army raincoat, issued June 9, 1942.

C. Material and Workmanship

C-1a. *Fabric*—The fabric shall be any suitable, plain weave fabric weighing not more than 4.2 oz. per square yard and having a breaking strength not less than 45 pounds in the warp and 32 pounds in the filling before dyeing. The fabric shall be an approved shade of sulphur dyed olive drab, show "fair fastness" to 10 days' weathering, and have a water-repellent finish, which shall be retained after coating.

C-1b. *Coating compounds*—The coating compounds shall be suitable polymerized or copolymerized vinyl resins suitably pigmented and plasticized. The compounds used shall be non-toxic and non-irritant.

C-1c. *Coated fabric*—The coated fabric shall be suitable for making raincoats and shall be an approved shade of dark olive drab. The pigmented compound shall be applied to one side of the fabric only. The compound shall have good adhesion to the cloth and may be very slightly struck through but shall not form a coating on the face nor affect the appearance; shall be flexible, free of tackiness, resistant to abrasion or scratching and shall not tender the fabric. When subjected to a temperature of 0° F. it shall not crack when folded sharply upon itself, with coated side out. The coated fabric shall conform to the following requirements (see Table I, page 110).

C-1d. *Cement*—The cement or sealing compound for the seams shall have good adhesion, flexibility and all other characteristics equal to the requirements for the coating of the fabric. Natural or reclaimed rubber shall not be used in the cement or sealing compound. Heat sealing will be permitted except for the joining seams of the raincoat provided adequate adhesion is secured.

D. General Requirements

D-4a. *Class "A" construction*—All seams shall be joined with double lapped and double stitched seams not less than 1/4 nor more than 5/16-inch gage (seam type LSc-2) and the seams shall be sealed on the inside of raincoat with a coating compound comparable with the fabric coating, by brushing, spraying or squigeing the compound onto the seams except that the shoulder and armhole seams may be made as in Class "B" construction and shall then be subject to the requirements for Class "B" construction.

D-4b. *Class "B" construction*—All seams shall be shingled and single stitched (seam type SSa-1) laid in cement, turn to one side and cemented down forming 1/2-inch seams; then strapped on the inside of the raincoat with 1 inch wide strips of the coated fabric, cut on the bias or with vinyl resin film strapping; strapping to center on seams. Hems on the bottom of the coat, yoke and sleeves may be turned up 1/2 inch and stitched 3/8 inch without cementing.

D-4c. *Class "C" construction*—All seams shall be single lapped (seam type LSa-1 except that no stitching is required) 3/4 inch wide, cemented, laid in cement and rolled so as to secure good adhesion of the cemented parts, except that the shoulder, armhole and collar attaching seams (*Please turn to page 110*)

11

***11**—To eliminate the possibility of friction or discomfort, and achieve smooth finish, flat finishing tapes are applied to sleeve sockets.* ***12**—Eyelets are cut and stitched in a single operation.* ***13**—Areas of hard wear such as pocket welts, collars and sleeve tabs are securely riveted for maximum durability, in one approved manufacturing method*

12

13

Product Development

Aircraft circuit breaker

A new small circuit breaker designed to meet the specifications of a number of aircraft manufacturers has recently been developed for the protection of airplane lighting, motor, radio and control circuits. Half the size and weight of larger units manufactured by this same company, this circuit breaker is housed in strong shock-resistant molded phenolic. The housing was developed in two halves (at left) with eyelets holding them together. The pins employed in the assembly of parts to the frame fit into holes molded right in the plastic part, making possible a speedy, rigid assembly without screws.

Inserts, impossible to mold in because of the two-piece housing construction, are provided at each side of the handle to permit assembly of the breaker to the back of the airplane instrument panel, with only the handle protruding through an opening in the panel. A cavity is provided in each half of the case so that internally threaded hexagonal inserts can be held in place when the two halves are assembled. The switch handle, formerly of aluminum, was also converted to molded phenolic, and is long enough to be operated by a pilot wearing heavy gloves. Lettering is wiped-in fluorescent paint.

Credits—Material: Bakelite, molded by Kuhn & Jacob Molding & Tool Co. for Heinemann Circuit Breaker Co.

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Fire-fighting fog nozzles

Fog—not the soupy London variety, but the synthetic kind consisting of a multitude of tiny streams that cross one another and break in a fine, even spray—is one of the most effective of all weapons for fighting certain kinds of conflagrations where inflammable liquids, intense smoke and dangerous gases are rife. Water absorbs not only the heat but the toxic gases of a fire and tends to clear away the smoke, and it accomplishes this most effectively when broken up into fine particles or spray. Hence the importance of the Mul-T-Jet nozzle tips which create fire-fighting fog when attached to any standard pipe or shut-off nozzle.

These are now molded of shatterproof cellulose acetate, comprise no metal or movable parts, and may be attached and detached with facility. Rust- and tarnish-proof, they are exceedingly lightweight, and are claimed to have sufficient strength to withstand any nozzle pressure used on hand lines, although capable of producing the finest artificial fog at only average pressure. The nozzles have been adopted for use by numerous large industrial plants and fire departments throughout the country, it is reported.

Credits—Material: Tenite. Molded by Northern Industrial Chemical Co. and Niagara Insul-Bake Specialty Co., Inc., for Mul-T-Jet Nozzle Corp.

Food blendor base

It was the traditional ill wind, weighted with benign results, that produced the redesigned Waring Blendor. Originally developed by Fred Waring, the Blendor, a high-powered device for liquefying a wide variety of fruits and vegetables without losing a vitamin, reached the point where priorities called for redesign. The new unit, developed in plastics, was produced by the use of ingenious molding technique and material development.

The new housing is transfer molded of a special phenol-formaldehyde transfer material on a two-cavity mold. More than three pounds of the material are injected into the mold with each shot. The unique shape of the housing necessitated the redesign of the standard compression molding press to receive the die, and to handle the transfer molding chamber. The conical housing covers the motor, providing space for insulation, and has reinforcing ribs (shown in the inset). Note the circular molded louvers to keep spilled liquids out of the motor.

Phenol-formaldehyde was selected for the new housing because it is strong, self-insulating, easy to keep clean, and pleasant to the touch.

Credits—Material: Neillite. Molded by Watertown Mfg. Co. Designer: Francesco Collura, Designers for Industry, Inc. of N. Y.

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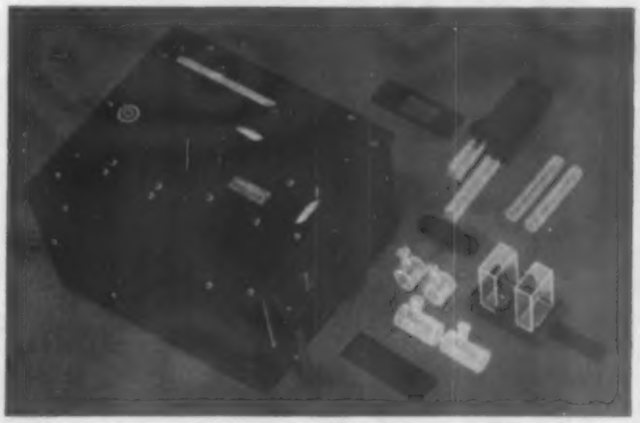
Precision instrument

Precision molded, fabricated and laminated plastics here combine to produce an accurate scientific instrument. The Coleman Universal Model II Spectrophotometer, designed for the modern chemical laboratory where light is used as an analytical tool, will pass color bands of light of any desired hue or shade through liquid samples. The absorption by samples under consideration makes it possible for a control chemist to record exact characteristics of any industrial product which can be made to transmit light, such as oils and fats, dyes, pharmaceuticals, liquors and plastics.

Phenol-formaldehyde laminated sheet stock is used for the panel of the instrument. The sample chamber is a phenol-formaldehyde tube, prepared in a mandrel and subsequently machined to accept the various parts of the cuvette aligning mechanism, and serving also to support the photosensitive element mounted on the rear, within another molded phenol-formaldehyde piece. The cuvette carriers, with their special molded covers, are made of the same material. The transparent windows are of cellulose acetate.

Credits—Material: Bakelite laminate; Lumarith. Molded by Schlotfeldt Specialty Co., and Coleman Electric Co., Inc. Optical system developed in conjunction with Dr. W. W. Wood, Johns Hopkins University



Product Development

Molding plastic-plywood

GENE VIDAL

WHEN, in the 17th Century, Robert Burton observed that "Cooking is become an art, a noble science," he was scarcely thinking of the lengths to which scientific "cooking" would go, or of the strange ingredients that would compose the finished dish. "It's cooking wood and plastics into any kind of shape," is Gene Vidal's own description of the process covered by his new patent—the process by which wood veneer bound together with a new low-temperature thermoplastic material is molded and welded into such dissimilar products as airplane wings and fuselages, gun stocks, boats, skis, furniture, caskets and truck bodies.

According to the description in the patent (U. S. 2,276,004, Mar. 12, 1942), the Vidal process is "a single operation method of molding, by means of heat and fluid pressure, plastic treated veneers which have been wrapped about a form into a completely reinforced or non-reinforced shaped structure." This simple statement reflects the result of four years of disappointment, the expenditure of large sums of money, and painstaking research not only by Vidal and his associates but by the laboratories of some of the leading chemical houses in America.

Interest in wood and its products has heightened in the few months since the WPB placed restrictions on the use of metal and banned hundreds of articles formerly made of aluminum, steel, iron and tin. Numerous concerns have sent their engineers and production managers to research laboratories to find out what is being done in the way of replacing metal articles which are no longer obtainable for home and farm use. Vidal does not claim that his process is a cure-all for shortages, or even that it will in future be applicable to the manufacture of some products for which it is currently adequate. There are many articles like automobile bodies which, after the war is over, can be stamped out more cheaply, he thinks, than they could be made by his new process, although some automobile men think the latter may be suitable for production jobs like special roadsters and station wagons.

"Our thoughts at the moment are on airplanes," Vidal says to those who question him about the possibilities of the process. "The Army and Navy have made their tests and they and aircraft manufacturers have been quietly placing orders with our licensees; the Canadian Government has had delivered hundreds of bomber parts as well as test fuselages made by this process."

In discussing the comparative costs of his products and those of metal, Vidal states: "With small quantity articles such as aeroplanes, boats, etc., the initial cost of the wooden forms indicates a tremendous advantage for this form of fabrication. As to costs of finished products, to date the results of estimates and analyses are indeed puzzling. In some instances the cost of an article so processed is but a fraction of the light metal article. In others it may be about the same. In the case of aircraft, the saving in the cost of a pursuit or bomber plane couldn't be a major factor since the engines, under-carriage and a thousand and one other parts couldn't be duplicated in plastic plywood. However, for small private planes with practically no gadgets and much simpler in design, a superior plane can be built for considerably less. Ralph Bell, Director of Aircraft Production for Canada, told me when he placed an order for the Anson bomber parts, 'This is the material and method we want!' "[1]

Plywood is not a new item in airplane construction: the very first heavier-than-air machines relied on plywood and fabric glued together. However, with the advent of the Ford all-metal plane, the discovery of new, light alloys, and the intensive work done by engineers of metal-producing companies, the United States turned to the metal plane. The difficulty of forming plywood and the probability of faulty joints through the old method of cold gluing gave aeronautical engineers the creeps whenever it was mentioned.

Germany, Japan and Italy, and Russia, England and Canada are using wood and plastics in their planes to great advantage. The much publicized "Zero" plane the Japanese are using today is wood and fabric, as is the German Messerschmitt. Although they are still building up flat or bent plywood piece by piece, and tacking and gluing their joints, Europeans are far ahead of the United States in the structural use of wood. It took a lot of persuading to bring American engineers around to seeing the worth of planes made by the Vidal process, because only men who are used to working in wood understand its advantages.

The idea for his process probably had its genesis in the $700 plane Vidal so ardently championed when he went to Washington as Director of Civil Aeronautics in 1933. Always an advocate of simplicity of design uncomplicated by intricate engineering problems, he wanted to see planes that were cheaper as well as better. This desire perhaps held him back more than anything else, because every time he found costs mounting he would begin building his planes all over again. Then, too he had at the outset a variety of other projects offered him each one practically a new venture in design and molding. At one point some fifteen different contracts were received, each article requiring a different technique.

Early in 1937 Vidal began actually working on his "cook-

[1] See MODERN PLASTICS, Nov. 1941, p. 154.

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PHOTOS, COURTESY VIDAL RESEARCH CO.

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ing." He had probed every plywood operation in the country, traveling from coast to coast, stopping off at any point that offered a clue to new methods. The first experiments were started in the Kellett plant in Philadelphia, but the problem of wooden molds led him to seek a woodworking plant and he moved to Paterson, N. J., where he found what he wanted in a pattern shop.

Molds play an important part in the operation, because each article to be made must be reproduced exactly in the solid wood forms around which the plasticized veneer (see Fig. 1) is eventually wrapped. This requires engineering and experience (Fig. 2), not only because of the curves and angles involved, but because the fabricated shell must be removed from the form after the cooking process. The slotting of the molds (Fig. 6) is extremely important, as it is this operation which determines the placing of reinforcement before the skin is wrapped on. The principle of the patent is not

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STEINMETZ

Scientific "cooking" is the inventor's description of this low-pressure molding method for producing plastic-plywood units. 1—Resinous glue is applied to thin strips of veneer which are dried in racks before use. 2—Solid wood mold must be drawn to exact proportion for perfect reproduction. 3—Thin strips of veneer are arranged in laiminated layers over mold for maximum strength. 4—Vidal bag holds entire half of fuselage in molding process

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only the curving but the welding of the reinforcing elements inside the structure (Fig. 8) at the same time that the structure itself is formed.

After the engineering of the mold comes the templating. This cutting of veneer to fit without waste (see Fig. 3), together with an arrangement of the various grains of wood in the laminated layers to give maximum strength, also calls for "know how." New ways of doing things are discovered almost every day. In the process of cooking under fluid pressure, it was necessary to protect the fabricated article from moisture because otherwise forms buckled and the plywood wrinkled and broke. Because of the warping it was impossible to remove the finished impression.

In the early stages of the process, wrapping was done with rubber strips, which didn't work. Then a great rubber bag was built, but this cracked and split as fast as heat and pressure were applied. The du Pont Co. had been working with the infant organization in developing low-temperature glues, because high-temperature plastics would not do the job. Intrigued with the bag idea, the du Pont engineers developed one of a new membrane which stood up under numerous cookings and in honor of the inventor named it the Vidal bag (Fig. 4).

Larry Marhoefer (who worked with Vidal in developing the patent and is the co-patentee), chief engineer at the Vidal Research Corp. laboratory, describes the bag as being like a rubber glove (Fig. 5). "Have you ever put on a loose rubber glove and dipped your hand in hot water?" he asks. "As the air goes out of the top, the pressure of the water molds the glove so tightly to your fingers and hands you can hardly draw it off. This is the principle of our bag."

Explaining the pressure idea further, he continues: "The whole thing is a matter of complete pressure. Each exposed surface of the thing we are molding has to have uniform pressure. We cannot use mechanical operations because too much of the energy is lost, by reason of the varying thicknesses of the laminated veneer. Fluid pressure is like the depths of the ocean. The deeper you go, the more complete the pressure. Ships' hulls which contain air are crushed like

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5—Drawn vacuum causes bag to adhere to object like rubber glove. 6—Before pressure is applied, fuselage mold is slotted and ribs inserted. 7—Plywood assembly is placed in large pressure tank, and steam and air turned on (hot air and water are both used in this process). 8—Interior of fuselage shows points of greatest strength where ribs and stringers are welded in. 9—After heat and pressure have been applied, fuselage is carefully sanded. Note smoothness of skin, curve of strut. 10—A modern Atlas lifts 68-lb. fuselage, completed without a screw or nail

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STEINMETZ

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egg shells." A special mechanism was developed for drawing the air from the bag, and this too was patented.

The pressure tanks are ordinary autoclaves (see Fig. 7). The bag and its contents are wheeled in, the tank sealed, and steam and air in exact proportions let in; water and hot air have also been used. The pressure is ordinarily about 20 lb. to the square inch, although for specific articles it may be higher. The heat is around 240 deg. F. This low heat satisfied early critics of former mechanical processes who claimed that high heat destroyed the fibers of the wood because of the varying amounts of water in different woods.

As he saw his process developing, Vidal found that he needed to be near an air field and about two years ago the plant was moved to a new site near one of the State's large flying fields. Orders had come in for plane parts and Vidal wanted to build a complete plane by his method. Money was needed, however, as models and modeling costs run high, and no customer was at that time willing to foot the bill for so new an enterprise.

Vidal talked to Nick Ludington, and he, together with the National Aviation Corp. headed (*Please turn to page 112*)

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Billion dollar business

PHOTOS, COURTESY BROWN & SHARPE MFG. CO

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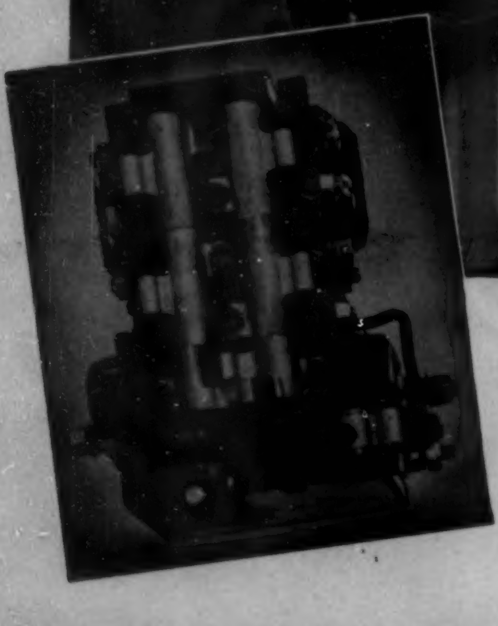

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"WARS are not won by machinery alone—but by the human spirit." That is a wonderful thought to be endorsed—but machinery will be very useful in bolstering the human spirit weighed down by the strain of battle. And behind the war machines are the tools which constructed them.

Because machine tools are so vital and necessary for the carrying out of the increased war matériel schedules, their production is still soaring to unprecedented figures. It is now estimated that total production, having reached approximately $800,000,000 in volume for 1941, will be well over one billion dollars in 1942. All manufacturers of this class of equipment, including their subcontractors, are striving to the utmost to complete their commitments, because time also is important. The situation created by the need for this additional volume of machines and parts, together with the critical condition of metal supplies, have given plastic materials an opportunity to prove their worth and adaptability for many machine-tool parts applications. As a result, even though machine tools under normal conditions would be one of the last places you'd look for extensive uses of plastics, the field is being rapidly developed.

Both molded and laminated plastics have been specified for the working mechanism of machine tools not only because they replace metals but also because they function with unique superiority, doing a more efficient job than the materials formerly used.

As a matter of fact, plastics have not invaded the machine-tool field overnight. They have been in use for many years, particularly where toughness and dielectric strength were the prime factors. Among machine-tool suppliers, Brown & Sharpe Mfg. Co., with a tradition of over 75 years of machine-tool building behind them, as early as 1935 adopted plastics in connection with the application of electrical controls. Now they list plastic pieces for many essential working parts, as well as for knobs, dial pointers, control handles, etc.

For example, high-speed automatic screw machines incorporate reversible spindles which are driven through automatically operated friction clutches faced with molded-laminated phenolic fabric. Rapidly revolving clutches (Fig. 6) must not only be positive in action but must stand up under rapid continuous operating cycles in production. The Brown & Sharpe machine of 1-in. bar capacity was designed for ex-

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ceptionally high-speed production, and combines uniformly rapid non-cutting movements with high cutting efficiency. The mechanisms for feeding stock and indexing the turret are driven from a constant speed shaft, completing their respective functions in $^1/_2$ sec. regardless of the spindle speed or rate of production. The spindle clutch is operated from this same constant speed shaft and reverses the spindle or changes speed in approximately $^1/_4$ second. In consideration of these rapid operations, the laminated phenolic clutch facings must take tremendous abuse in changing speeds, reversing directions in split seconds without overheating, trouble or failure.

In order to improve smoothness, speed and efficiency, another feature of this machine and of other equipment of the company is laminated phenolic fabric gears. Such gears are cut from blanks of phenolic impregnated cotton duck laminated and processed in a hydraulic press under a high degree of heat and pressure. In addition to possessing strength, toughness and long life, these accurately machined plastic gears are said to be 30 to 40 times as resilient as steel, and to permit tooth deflection which absorbs vibrations and reduces operating noises (see Fig. 5).

In the Brown & Sharpe electrically controlled plain milling machines (see Fig. 1), plastics play an important role throughout. For example, the power to spindle and table motors is handled through magnetic switches built into the rear of the column of the machine. These switches are controlled by the relays on a panel in the right side of the column. The coolant pump motor is stopped and started by a manual starter on the spindle control switch panel. Power to the spindle motor goes through contractors (magnetic switches) in the lower part of the column and thence to the motor. The spindle brake solenoid is also operated by this circuit. Power for table movements is handled through reversing contractors and two speed contactors located in the upper part of the rear of the column. In the right side of the column is the relay panel, the purpose of which may be explained as follows:

The spindle control switches on the front of the column, together with the viscosity switches, the gear case switches and the various dog- or hand-operated switches on the front and rear of the table, open or close circuits which cause the proper magnetic relays on the above-mentioned relay panel to operate. These relays govern circuits which operate both the fast travel solenoid and the magnetic switches in the rear of the column so as to give the various movements of table and spindle determined by the setting of the dogs and switches.

In this entire electrical system, starter buttons, control knobs, terminal blocks, terminal insulators, feed control blocks, switch blocks, single and double throw switches, relays and other parts are all molded from the best and most practical plastic materials for the job at hand. Such parts must be precision molded and must maintain exceptionally accurate dimensions. This complete electrical control assembly (see Fig. 2-3) depends entirely on plastics for vital insulation, strength and compactness. The feed control switch block pictured in Fig. 4 is typical. This single unit, used as a switch block base to which nine terminals and contacts are easily attached, combines several functions—saving space, increasing efficiency and cutting fabricating and assembly costs. The rag-filled compound has the extra strength required for long operating life, and is self-insulating.

Plastics have a real future in the machine-tool field. As machine tools become more automatic, thus requiring many additional electrical parts, the demands for strong, self-insulating plastic materials will increase. In addition to molded and laminated parts for the "innards," fabricated sheet stock for dials, nameplates and other insignia will find a place because of its ease of fabrication and cleaning and its color range.

Credits—Material: Textolite. Molder: General Electric Co., Plastics Dept.

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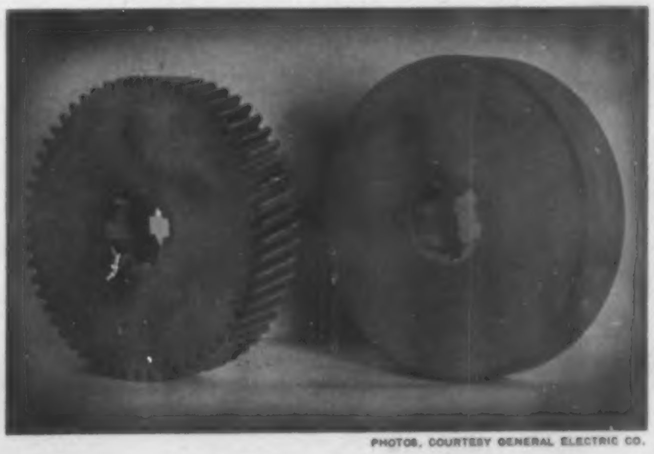

PHOTOS, COURTESY GENERAL ELECTRIC CO.

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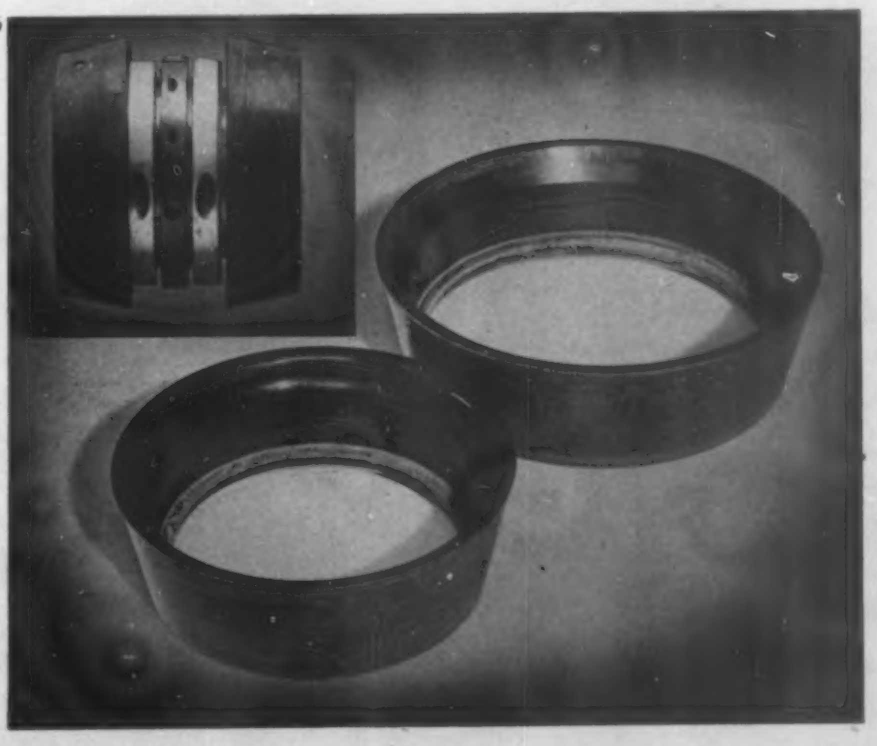

***1**—Column of electrical control panels of a plain milling machine relies on many compact phenolic moldings for insulation and support of vital working parts. **2**—Central electrical control unit for the milling machine with cover removed to show mechanism. **3**—Plastic table control switch block, complete. **4**—Extra-strong rag-filled phenolic is used in this feed control switch block. Control buttons on top are self-insulating, terminals and contacts easily attached. **5**—Durable, resilient gears of woven-fabric phenolic laminate reduce noise and vibrations. **6**—Laminated phenolic clutch facings stand rough wear at rapid, changing speeds. Inset shows friction clutch assembly*

Wired window protection

Clear laminated cellulose acetate sheet with wire mesh reinforcement withstands shock of bombing and other explosions, won't shatter

SINCE English civilians first found that clear plastic films or coatings of many types could be used to replace "bombed out" glass and reinforce windows and skylights, these non-shatterable shields have done yeoman service in preventing injury due to flying glass. Latest to join the ranks (which include laminated cellulose and cloth, cellulose dipped or coated wire or scrim, cellophane patched glass*) is a laminated cellulose acetate-wire sandwich. This is formed of a 16-mesh wire screen approximately .030 in. thick, laminated between two .015-in. sheets of clear cellulose acetate sheet. Though the component layers total .060 in. in thickness, the final product is .030 in., forming an integral reinforced structure. This is being used in much new Navy construction work instead of glass.

In addition to its excellent resistance to shattering or fragmentation due to concussion or bomb explosions, this new reinforced acetate is said to be tough, strong and have high impact resistance. According to the test report, a $^1/_2$-lb. ball dropped from a height of 9 ft. had no effect on a window sash glazed with this material. In other tests made under vacuum shock conditions, the laminated plastic is reported to have shown no appreciable damage at 28-in. vacuum, while clear window glass was blown out at 15-in. vacuum; glass coated with safety material at 22-in. vacuum, and heavy wire reinforced glass at 26-in. vacuum. In further tests, made by the Bureau of Yards and Docks, a $^1/_4$-lb. ball dropped 20 in. smashed ordinary glass and cracked safety glass, leaving a sunburst pattern. A 2-lb. ball was dropped from a height of 42 in. before the plastic laminate was penetrated and even then the hole was clean-cut with no shattering.

* "Shatterproof Shields," MODERN PLASTICS, March 1942, page 38.

The plastic laminate may be repaired with cellulose tape and its breakage resistance after repairs is approximately the same as that of a solid piece. Optical qualities and light transmission are approximately equivalent to that of a window with a metal screen in front of it (see Fig. 1).

Although laminated into a rigid product which can be installed in most existing types of wood or metal sash, the reinforced acetate-wire combination is still thermoplastic, and therefore can be drawn or formed into special shapes. Drawn or formed sections of the material are claimed to have higher resistance to heat deformation than normal thermoplastics.

Installation

The most satisfactory method of installation in a wooden sash makes use of a drawn sheet of the material. As a result of the drawing there is a $^1/_4$-in. flange clear around the outer edge of the plastic "light" (or window pane). When the sheet is inserted in the wooden (*Please turn to page 108*)

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PHOTOS, COURTESY MONSANTO CHEMICAL CO., PLASTICS DIV.

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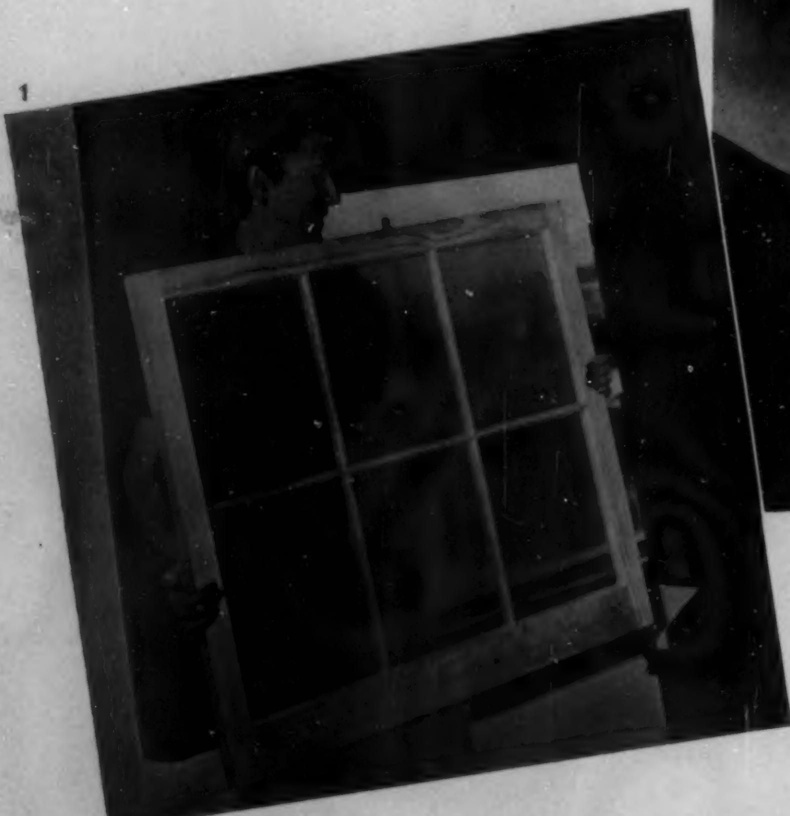


1—Designed for human safety and property protection, sturdy plastic laminate with wire screen filler is being used for shatterproof windows. Light, impact-resistant, they admit light, keep out heat. 2—Panels are easily installed in conventional, multi-paned wood or steel sash, are stapled, weatherproofed with putty filler

These forms illustrate production stages in making a molded woodpulp plastic sachet container, about 1 1/2 in. in diameter. A—Plaster of Paris covered model; B—Plaster mold; C—Completed plaster pattern, male and female halves; D—Bronze mold sections; E—Finished piece as it comes from the mold

Woodpulp plastic products

by AUREN W. URIS*

SUBSTITUTE materials for non-defense production are the Cinderellas of the hour. "Sub-plastic" molding compounds, previously ignored even in the most complete statistical charts or condemned to anonymity by the designation "other," are now discarding their stepchild status. They are being sought after and used successfully in a wide range of applications, doing the job of metal and synthetic resin plastics where these are no longer obtainable.

One such material, known generally as woodpulp plastic and molded under the name of Tritex, is at the moment available in unrestricted quantity. This molding compound, consisting of a cornstarch-rosin binder and various fillers to suit the job on hand, is made up at a cost of about 4 cents per pound. It is not sold as a molding powder but is shaped into various articles by its producer, using hand-operated toggle presses. Molds used are cast bronze which are relatively inexpensive, averaging about one-quarter the cost of steel molds.

Preparation of this woodpulp plastic requires only the physical mixing of the ingredients, after which it is ready for use. Molding temperatures range from 300 to 350 deg. F., and pressure is about 400 lb. per sq. in. Thicknesses from $^3/_{32}$ to 1 in. have been molded, with cycles ranging from 4 to 15 minutes, respectively. The material is thermoplastic, and scrap and rejected pieces can be ground and re-used. In practice, a certain percentage of reground material is put into the molding mixture to cut down on molding time and also to strengthen the molding. The fact that this scrap does have changed qualities indicates that a certain amount of chemical action has taken place.

To overcome the comparatively low output of hand-operated presses, multiple-cavity production molds are used. Three-inch diameter moldings on a run of about 50,000 pieces, for instance, would be produced on an 18-cavity mold. This gang mold would be mounted on two cast-iron supporting frames in rows of nine, both then being adjusted in a single press. The iron frame affords, first, a convenient means of attaching the molds to the platens and, second, a mounting space for the gas pipes which supply flame directly to the molds. There are two standard platen sizes, 22 by 29 in. and 30 by 30 inches. A single operator can work two presses, stripping and loading one while the moldings cure in the other. Working the 18-cavity mold described above, it is said that 50,000 pieces can be turned out in about five weeks. This time can be halved by running two shifts or using a second set of molds on a second press. However, it is desirable from a production standpoint to have a fairly extensive run. Four weeks is about a minimum satisfactory length, though much shorter runs have been undertaken when an increased selling price permitted absorption of set-up costs.

Uncoated moldings of the woodpulp plastic have the appearance of grainless wood, color and finish usually being applied by such industrial finishes as lacquer, synthetic enamel or woodstain. Color selection is practically unlimited, since lacquer is unaffected by the molded material, thus permitting of white and pastel shades. While surfaces comparable to the synthetic resin plastics are not easily obtainable, a filling and sanding operation can overcome porosity in the moldings and bring them close to the smoothness of the synthetics. Aside from color, there are also innumerable texture possibilities. Gloss, matte, wrinkle, crackle, pearlescent, tinsel and two-tone antique effects may be had. The cloth-like surfaces derived from flocking with cotton or rayon can also be produced. A very inexpensive but rich-looking finish is obtainable by the use of woodstains. Single applications of such stains in a dipping bath, followed by a wipe-off, have given excellent wood simulations. This method of coloring has value in instances where it is desired to reproduce hand-carved wood effects. (*Please turn to next page*)

*President, Tri-Plastic Advertising Co., Inc.

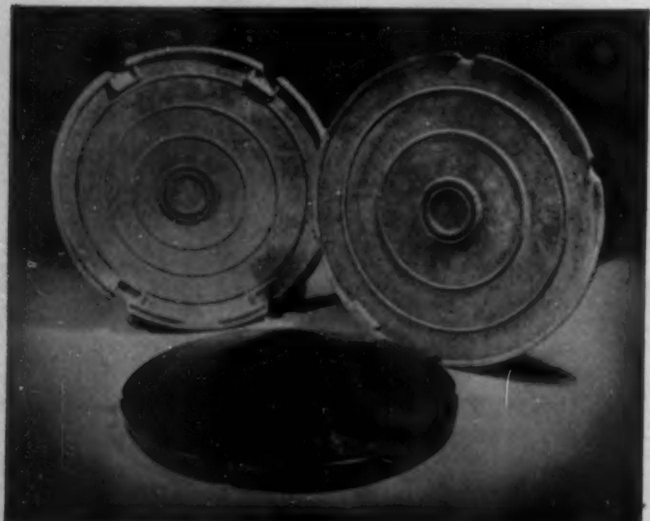
Experiments in pre-coloring have been tried with partial success. The colors so far achieved leave something to be desired in the way of intensity and uniformity, but in certain kinds of low-cost items, pre-coloring of the woodpulp plastic is practical.

Limitations

Limiting factors in design for these moldings differ in degree from those of the synthetic resins. First, as regards ornamentation, much wider latitude is permissible. Since the molds used are cast bronze, there is no expensive mold machining involved. It is inadvisable to design fin-like projections since a pressure of 400 lb. per sq. in. is insufficient to force the molding compound into a narrow mold-crevice to form such a fin. Correct design would substitute a thicker projection to permit a "peak" in the mold on the reverse side to force the material into the crevice.

As to provisions that may be made for assembly, the molding illustrated in Fig. 2 is an interesting case in point. This cone-and-cover unit was originally made of metal, both stamped and spun. When metal became unavailable, it was decided to reproduce the piece in woodpulp plastic. The question then arose as to how the four supports fitting into the quarter-round holes could best be attached. In the metal pieces, nuts had been fastened to the inside of the cover and machine screws then passed through the supports into the nuts. This had not been altogether satisfactory because of the necessity for exact alignment to have the screw and nut engage. It was accordingly decided to mold accommodations into the cone section into which small wooden blocks could be wedged. The assembly then was done with wood screws, removing the necessity for extreme precision in assembly. The standard devices for molded assembly accommodations also are possible, including the use of inserts.

2—Ventilating unit cones, 14 in. in diameter, molded from woodpulp plastic. Two halves in back show inner ribbed construction. 3—A 12-in. housing for a movable display, irregular in shape, was economically produced in small quantities from woodpulp plastic



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Molding limitations are somewhat more stringent than for the synthetics. Greater draft and shallower draws are required. A five-degree draft is about the safe minimum. While there is no specific limit to the depth of draw possible, the deeper the draw the greater the tendency toward porosity and other failures. Cross sectional thickness depends on size and strength requirements of the projected article. Full-round items are manufactured by molding halves which are glued on a joint that can be made invisible by a buffing and smoothing operation. This gluing process is an efficient one and such full-round items can be produced at low cost.

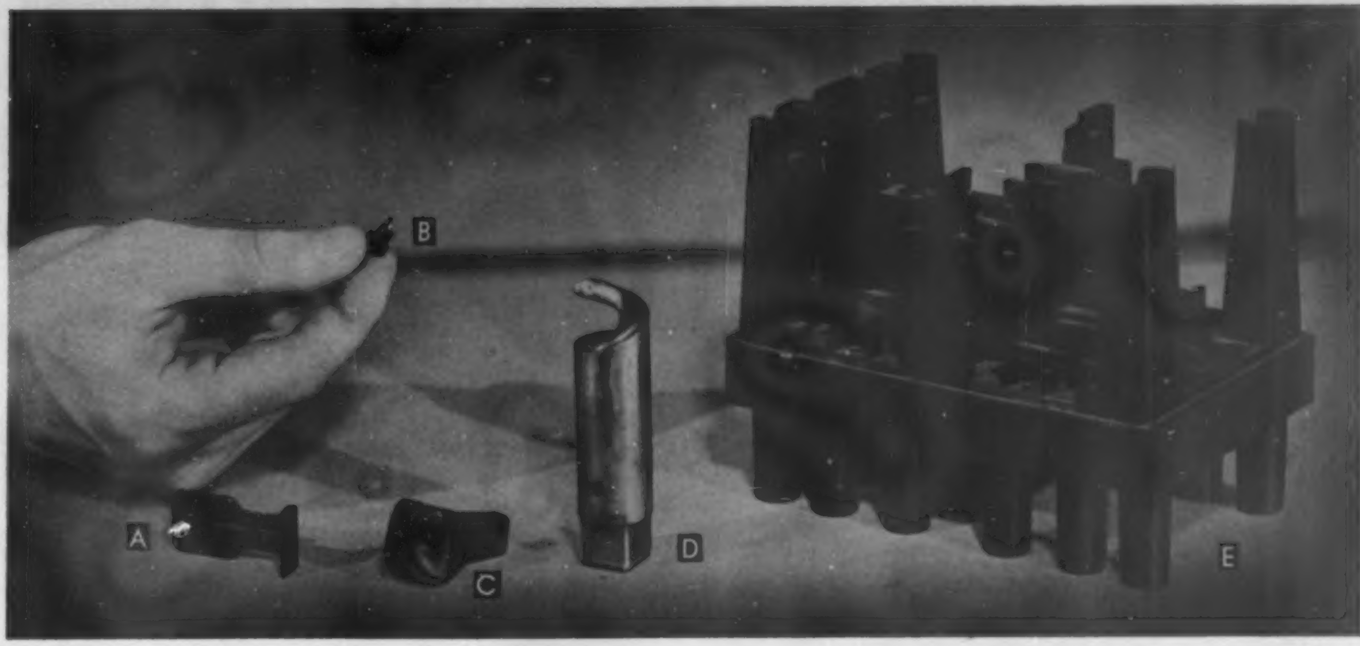
A brief, simplified description of mold-making procedure is here given to clarify the entire process. Suppose that the piece to be made is a 5-in. diameter hemispherical shell of $^1/_8$-in. wall section: a model of this shell is obtained, probably as a wood turning. The model need only represent the face of the item to be formed in the female mold. In other words, this wood turning can be solid for, as will be described, the male mold is made from the female half rather than from the model.

To make the mold pattern, the model is set down on its flat side and plaster of Paris is poured over it. After the plaster sets, the model is removed and two register points are cut into the plaster. We now have a square block containing a hemispherical cavity and two female register points. To the inside of the cavity is applied a uniform layer of clay equal to the desired wall thickness, in this case, $^1/_8$ of an inch. Plaster is then poured over this plaster block. When the second pouring hardens, the two blocks are parted and the clay layer is removed. It will be noted that we now have two square blocks of plaster, registered at two points, which, when put together, surround a cavity representing the item to be molded. The plaster blocks are then trimmed to form a flash edge around the cavity and the two blocks are scooped out from the back to cut down on the amount of metal needed, as well as to permit quicker heat transfer to the face of the molds. These plaster patterns are then duplicated exactly at the bronze foundry. The resulting castings are the actual working molds (see Fig. 1).

Physical properties of this woodpulp plastic cannot be given in the form of specific figures, since testing of this material has not been of a laboratory nature. This is because previous applications were mostly in the advertising display field, where specifications are much less demanding. Recent applications, however, have included bases for perfume packages, displays, 14-in. diameter cones used in a ventilating unit (Fig. 2) and a 12-in. housing with accommodations for subsidiary parts (Fig. 3).

These moldings, after a coating of lacquer or enamel, become practically impervious to atmospheric conditions. Although the basic material is susceptible to the action of water, lacquer-coated sections have been immersed in water for days without any noticeable deterioration, it is reported.

The strength of ordinary moldings is approximately that of wood. Recent experimentation, (*Please turn to page 116*)



Speed begins with the dies

Molds designed to conform exactly to the plastics parts to be produced therefrom are the result of advancements in engineering technique; and speed of production and lowered costs bespeak the progressive toolroom

THE success or failure, the appearance, quality, accessibility, even the cost of a finished molded plastic product, are all dependent directly or indirectly upon the efficiency of the mold. The construction of a mold requires the precision, skill and ingenuity of the master technician because successful molds can result in great production savings. For example, one company reports that molds skillfully designed to conform with the exacting requirements of the plastic parts to be produced therefrom have enabled their mold-making department to increase the production of dies as much as 400 percent during the last year. These molds are said to have resulted in an inexpensive and speedy means of production of intricate molded parts, and to have facilitated production of such parts in quantities running well into the thousands. Several interesting cases, which are discussed below, demonstrate how initial problems were overcome with great skill and engineering technique, and resulted in dies whose efficiency has been demonstrated repeatedly. These are typical of the type of activity current in progressive toolrooms throughout the plastics industry.

In one instance, first attempts to drift or press the 0.002-in. step on the end of a right-angle piece (shown above, A) failed because the distortion in the heat treatment of the die resulted in nullification of the drift. The solution to this problem was arrived at by hardening separately a small insert with this 0.002-in. step, and then fitting it into the main die. The preliminary hardening overcame the heat distortion, and the resultant die has the precise and sharply defined characteristics essential to perfect reproduction of the finished parts.

The tiny "button" (shown held in hand, B) is made in a 24-cavity mold, with each cavity identical with the rest. In order to ensure the essential strength and proper clearance, the point of junction for the eccentric diameter had to be held to an 0.008-in. radius; and to achieve these specifications, the top die of the mold which forms the head of the button was hobbed or cold pressed from a master hardened steel tool hob. The bottom dies were bored in a lathe and then counterbored eccentric with a series of specially built drill blocks, gun drills and reamers. The 0.008-in. radius was then drifted on the eccentric diameter by means of a master drift which ensured precisely the same radius for all cavities in the mold. In the final inspection, this 0.008-in. radius is magnified 65 times to make certain of the uniformity of all pieces.

Another case history exemplifies the use of a model as a three-dimensional guide or mold pattern. This expedient was necessitated in the construction of a scroll die (C and D) because this design was exceedingly difficult to produce on paper. A model 8 times the normal size was therefore constructed in wood and the mold, reduced to the required specifications, was machined from the wood model. The proper curvature and shape were procured by filing the center core, and checking minutely against the model dimensions until a similar form was achieved.

An unusually complex part is the molded relay base at right (E). The various shaped parts on top of the relay base were formed from 21 separate die parts. Exact, perfect fitting of the mating parts in order to avoid heavy fins in the final molded piece was the important aspect of this construction. This tightly fitted mold assembly ensures dimensional accuracy in the finished plastic part and consequently correct functioning of complete units.

Credit—Molding and tooling by Westinghouse Electric & Manufacturing Co., Plastics Div.

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Plastics in Review

1 Decorative diffuser for fluorescent lighting fixtures, this unit was designed to be installed in individual sections or in continuous lengths. Deep drawn from .020 Vuepak by General Plastics Corp. for the Curtis Plastilux, its design permits a relatively high light brightness on the lower part of the shield and a low light brightness on the sides. Unit is 48 in. long, 15 in. wide and 7 in. deep. Lightweight and durable, the plastic shield may be easily removed by applying slight pressure along the sides

2 Eye and service appeal are happily combined in the "Kulka" weatherproof electric socket molded of Durez by Terkelsen Machine Co. Cutaway section reveals combination of molded phenolic and porcelain. Self-insulating and physically tough, the plastic is used for the outer shell because it is practically chip- and crackproof, even under comparatively rough handling, and it will not absorb moisture

3 For that Victory Garden in the window box, a gay colorful sprayer with Tenite bottle cap, pump handle and nozzle connection. They're rustproof, and virtually unbreakable. Molded by Harco Products Co., and distributed by the Germain Seed & Plant Co. Cap is designed to fit standard quart Mason jars so the sprayer may be readily transferred to other jars

4 Helping to speed up aircraft production, this oil gage glass now in use for one of America's new medium bombers is rapidly injection molded of Crystalite by Detroit Macoid Corp. Formerly machined, threaded and polished in separate operations, it is now turned out complete in a single cycle, requiring only minor finishing operations. The clear acrylic gage is reported not only to be capable of retaining its transparency indefinitely, but to be resistant to the effects of oil and to withstand impact without breaking

5 No more crossed wires or cross dispositions with a No-Kink plastic telephone cord which not only contributes to a smoothly functioning communication system, but helps to preserve and maintain telephone wires in good repair, replacing rubber protective stripping for this purpose. Manufactured both by the Keystone Brass & Rubber Co., and by Frank Paper Products Co. of extruded Tenite II and Ethocel, respectively

6 Academic mariners in high school and college physics laboratories will now be equipped with compasses in transparent Lucite cases, molded by Chicago Molded Products Corp. and marketed by Chicago Apparatus Co. The plastic cover on small compasses is molded into a magnifying lens which makes the tiny dial figures easy to read, and provides top and side visibility. The plastic material replaces the brass case and glass lens of the French compasses previously used, is practically unbreakable, and there is a minimum of discoloration

7 On submarine or surface craft, visual signal controls are easy to read when their dials are of shock-resistant, translucent plastic. These are cut from stock Catalin sheets $^{3}/_{16}$ in.

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thick, beveled and silk-screened to specifications by Plastic Turning Co., Inc. Pointers, too, are cut from the same cast phenolic sheet material and machined to shape. This thermosetting resin has high compressive, flexural and tensile strengths, and resists oils, acids, lubricants and grease. Non-flammable and practically non-water-absorbent, it is well adapted to use on shipboard

7

8 High style in first aid will make that old headache vanish under the ministering of this attractive checked icebag fitted with a Durez molded cap. Substantial and easily gripped, the cap will not corrode. Integrally molded threads are not likely to strip. Cap is molded for Lobl Manufacturing Co. by Terkelsen Machine Co.

9 Warm weather aid—Westinghouse Co.'s electric fans, which have used a molded plastic in the escutcheon ring at the center of the cage which protects the blades. The change not only saved metal but is reported to have eliminated noise vibrations and reduced the weight of the entire fan. The plastic material is inherently colored, requiring no finishing operations, and there can be no chipping of paint in use. Molded of Lumarith by the Bryant Electric Co.

10 The Uniturn Indicating System, developed by the Braidwood Stamp Co. for operating panelboards and wall maps of electrical utilities, electrified railways and industrial pipelines, makes use of a variety of plastic materials. Photograph shows a back framing of $^{3}/_{4}$-in. resin-bonded plywood on which are bonded $^{1}/_{8}$-in. panels of Formica laminated sheets. Multicolored balls machined from two-toned Bakelite cast resin rods constitute the changeable indicators which are visible through beveled openings in molded cellulose acetate face-plate retainers, pressed through drilled sockets for code purposes. Vulcanized fiber lines, heat cemented to the front plates with a Vinylite resin adhesive, connect the bull's-eye color spots for electrical power systems. A different color line designates each voltage level

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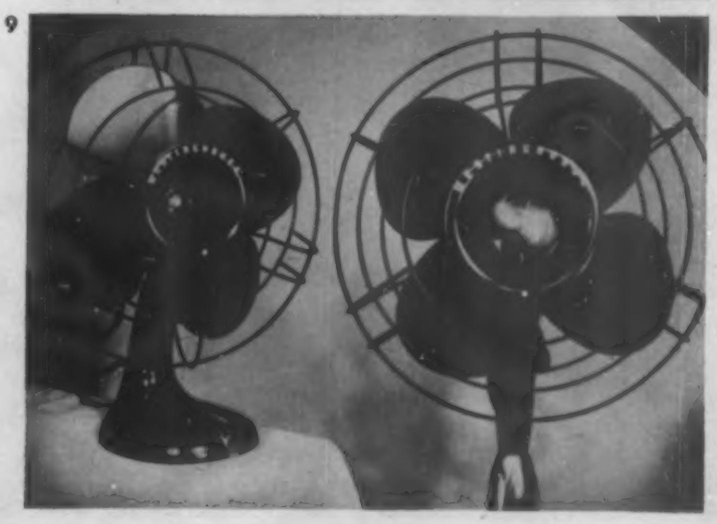

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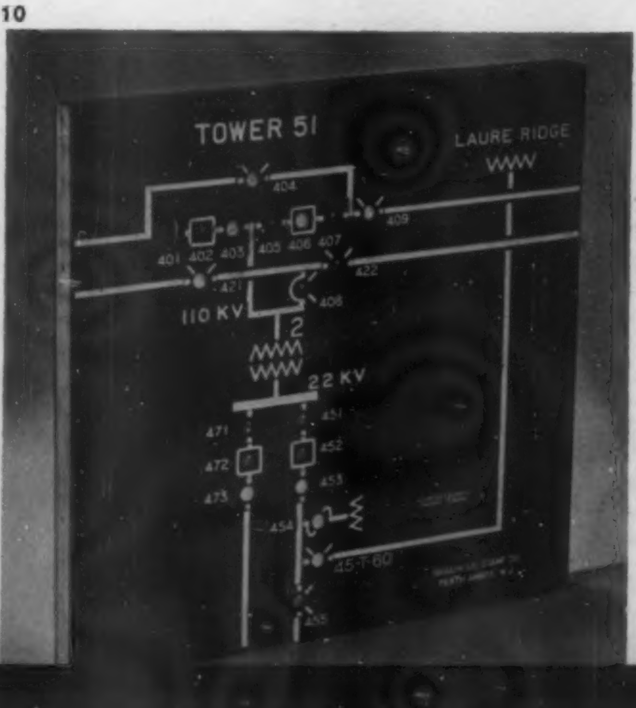

Converting for Uncle Sam

by E. F. LOUGEE*

IN the countrywide scramble to convert peacetime plant facilities to wartime production, small manufacturing concerns have complained bitterly of being "forced out of business." The Government has stepped in to make things easier for some by farming out subcontracts to those who can handle them. Other small independents, through sheer determination and adaptability of personnel and machinery, were able to secure quantity contracts on their own and complete them with facilities formerly devoted to civilian projects. High on the list of these latter progressives is the Allied Plastics Company.

Gas-mask lenses are the primary contribution of Allied to the war effort. In October 1940, when war seemed far away from our shores but close enough to start home defense activities, they began making lenses for training masks. Even before war hit us, they were ready to jump into production of the tremendous quantities of lenses needed for service masks as well as for trainers.

They were ready because all the preliminary stumbling blocks which so often precede the creation of a new item in plastics had been worn down or pushed aside. To see their injection molding presses today, working hour after hour through three shifts a day, seven days a week, turning out gas-mask lenses to conform with the stiff specifications set up by Chemical Warfare Service, it is difficult to appreciate the great amount of planning and hard work that was done before production began.

"As with all good plastics molding jobs," says D. C. Hirsh of Allied, "the story of plastic gas-mask lenses begins with the steel mold. Its chrome surface had to be hard enough to stand the pressure and sufficiently smooth to prevent any possibility of waves or striae in the completed lenses. Good mold makers, free to do the job, were hard to find and we finally had to arrange to make the molds ourselves."

With the mold taken care of, there came that critical period of experimentation and selection of the plastic compound best suited to the lenses. Acrylics were tried at first, but cellulose acetate was finally specified by Chemical Warfare Service and is used exclusively today by the various firms who are also making gas-mask lenses. Because of variations in batches of cellulose acetate, which no amount of care seemed to be able to overcome, this company set up its own formula with the plastic materials manufacturer with whom they work.

Other getting-ready activities had to be attended to before real production began. To get the results they were after, the company found it necessary to make their own heating cylinders, rams and knock-outs for the injection-molding presses. Air-conditioning equipment had to be installed in the molding room because particles of dust settled on the mold between shots. This just couldn't be because each lens must be perfect or it cannot be passed. More time had to be spent in devising a method of removing gates, sprues and runners without cracking the lenses. This they accomplish by cutting with a hot knife while the molding is fresh from the press and still warm.

Now in full swing, the plant operates at capacity with scarcely a hitch from one day's end to the next. The efficient, well-coordinated procedure goes something like this. Plastic compound, received from the materials supplier in drums, is emptied into huge shallow pans which slowly

* Plastics Institute.

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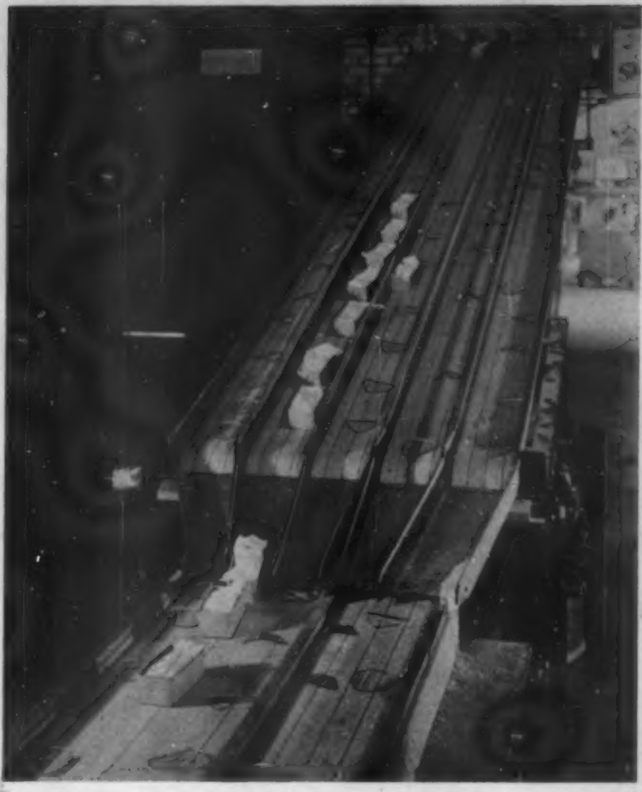
PHOTOS, COURTESY ALLIED PLASTICS CO.

1—Cellulose acetate gas-mask lenses are molded in an air-conditioned room to keep out dust. Press operator (center) examines them briefly before they are snipped from the sprue and runners, put on a conveyor belt which hoists them aloft and through the partition to the next room



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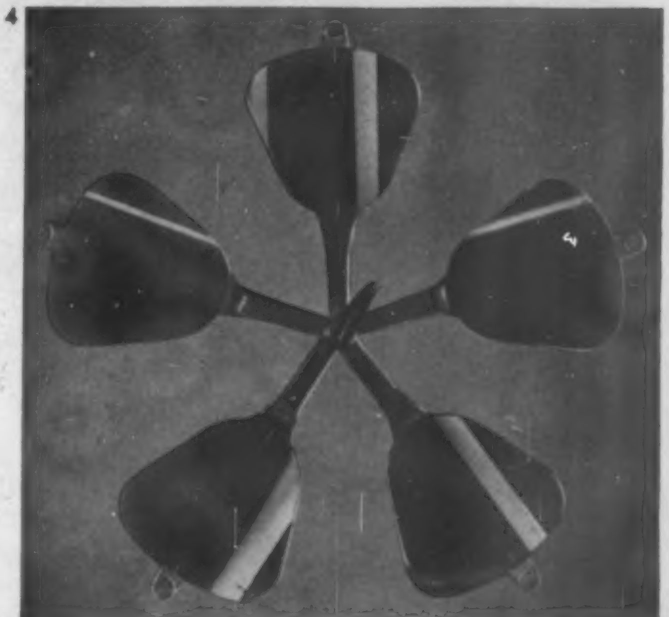

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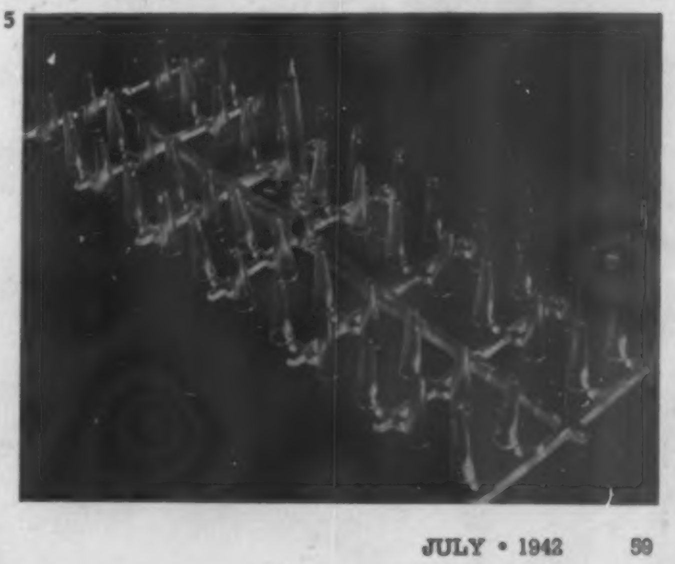

2—Conveyor belt deposits lenses in inspection room. 3—Girls make the best inspectors. 4—Lenses are injection-molded 5 to a sprue. 5—Springs for incendiary bombs are packed in tiny conical holders made from acetate scrap

revolve under infrared lights until every last trace of moisture is removed from each separate particle and the compound is slightly warmed. In this darkroom, the thoroughly dried compound is packed in cans to be removed to a room where the temperature is kept between 90 and 100° F., where it is stored. The manufacturer attributes much of his success in getting a sufficiently clear lens to meet CWS specifications to this process of treating the compound with infrared light.

From the storage room, the compound goes directly to the hopper of the injection press and down into the heating chamber, where it awaits its turn to be shot into the five-cavity mold. About twice a minute the mold opens just long enough for the operator to pick out the hot molding (Fig 1). The lenses are quickly examined for imperfections, then placed in a cutting device beside the press where gates, sprues and runners are swiftly and easily snipped off by an air-operated, heated knife. The separated lenses are placed on a conveyor belt which carries them up to the top of the room, through a partition, and down an incline into the next room where they reach the inspection point (Fig. 2).

Government inspectors check each lens for size, breakage, thickness, clarity, waves and striae, etc. If the lens passes muster, it continues on to the packing station. Rejects, discarded because of minor defects, are put aside and about 3 days a month are devoted to sanding and getting these rejects into condition to be sent along again for inspection. Otherwise, no buffing or finishing of any kind, except trimming, is necessary.

Both press operators and inspectors are girls. "They are more gentle and careful than men," the company says, "and consistently deliver a greater percentage of perfect lenses. Since we have (*Please turn to page 120*)

Thousands of these Plaskon-equipped electrical control panels are used in war equipment factories, where steady illumination and uninterrupted current are absolutely essential for high-speed 24-hour day and night production.

1

1—Important parts of aircraft construction are properly functioning plastic guide blocks shown above. Inset shows assembled and unassembled parts

Fairlead guide blocks

UPON the humblest component part of a plane rests the responsibility for the safety of the entire structure. Each link in the chain of construction must be forged securely, with precision and strength and skill so that not even the smallest factor in the mechanism shall betray the security of the pilot and crew, or endanger the plane's functioning. One of the most significant behind-the-scene hazards is the danger of control failure, due to jamming or snapping of the control cables, which might be caused by the friction of the cable against one of the sharp edges of metal surfaces of the plane. To guard against such a contingency, and to insure free and unhampered operation of the cables, all of them, where they run through holes in bulkheads, ribs and other structural plane parts, must pass through protective fairleads or guide blocks.

In the past these fairleads were made of hard rubber. Later, a variety of plastic materials such as laminated phenolic, vulcanized fibre and even injection-molded thermoplastics such as cellulose acetate and cellulose acetate butyrate were used. Laminated blocks (Fig. 2) were generally constructed in split block sections with fairlead holes drilled, counterbored and filed smooth to permit free passage of the control cables, and to prevent them from touching or vibrating against the raw edges of metal surfaces of the plane. The installation of the control cables required a high degree of skill and absolute precision in order that they be perfectly

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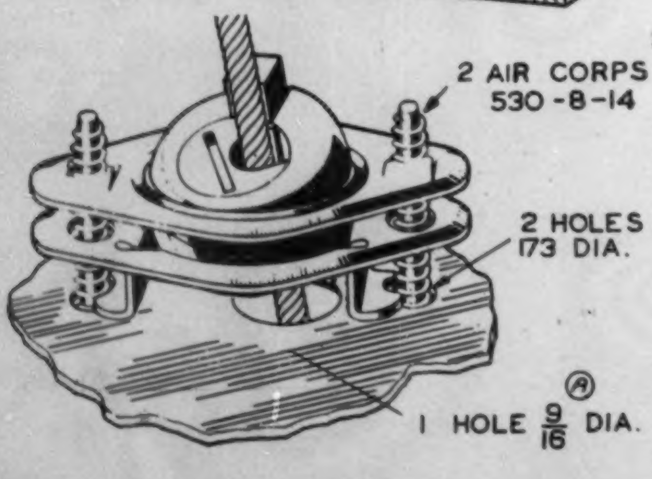

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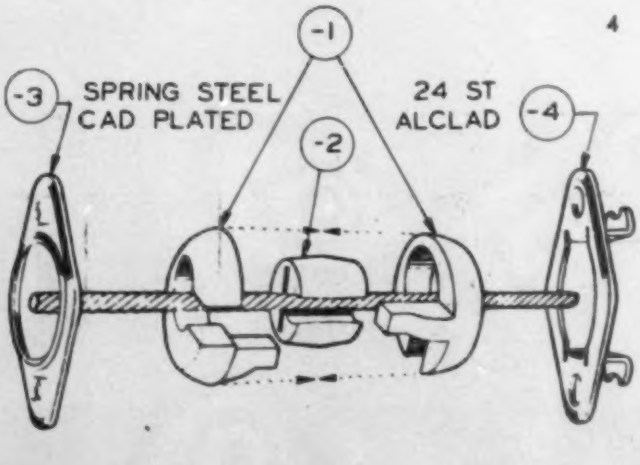

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aligned with the fairlead. To achieve this degree of accurate positioning, and to make sure that the cable would pass through the fairlead freely and without interference, it was necessary in the past to drill the hole in the structure and assemble the fairleads when the cables were installed. Because of the variances in the large bulkheads and other structures, which might cause the holes in the fairlead to be out of line with the cables, the guides could not be pre-drilled or punched but had to be custom fitted to conform with the specialized needs of the installation.

All that has now been changed with the development of an ingenious adjustable plastic fairlead guide block, recently introduced. This "Speed-align" fairlead, reminiscent of a miniature jig-saw puzzle in appearance, consists of three pieces of molded macerated phenolic which, when fitted together, lock into position to form the guide block (Fig. 1, inset). The two matched housings are positioned with lugs so that the angle of the opening is adjustable. The center plug, or retainer barrel, has a scooped-out section which serves as the major bearing for the cable. The assembled plastic guide is supported between an aluminum base and an aircraft steel speed nut as shown in Fig. 1. This plastic guide is "universal" to any angle of the cable (see Fig. 3), and its use eliminates the necessity for drilling special angular holes in guide blocks. The eccentric center plug has screwdriver notches across both diameters and is rotatable so that the fairlead hole can be lined up to any point within an area of approximately $^{11}/_{16}$ of an inch in diameter. A feature of special significance peculiar (*Please turn to page 112*)

2—Earlier model fairleads were laminated blocks constructed in split block sections. 3—Speed-align guide is "universal" to any angle of cable. 4—Easy to assemble, plastic parts are placed over cable, and aligned and slid together. 5—Diagramed sketch shows construction of guide. 6—Fairlead without aluminum base rests in $^{29}/_{32}$ in. diameter hole. 7, 8—Diagram shows typical structures which do not allow $^{29}/_{32}$ in. diameter hole for fairlead housing. 9—2-piece graphitized phenolic guide

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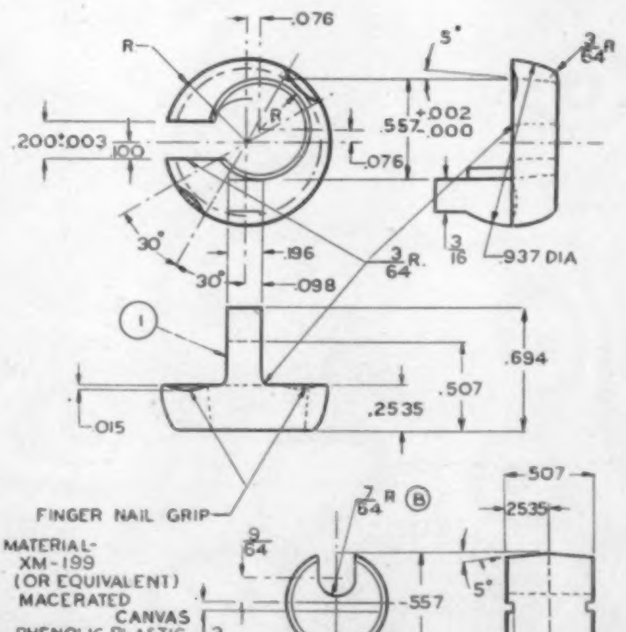

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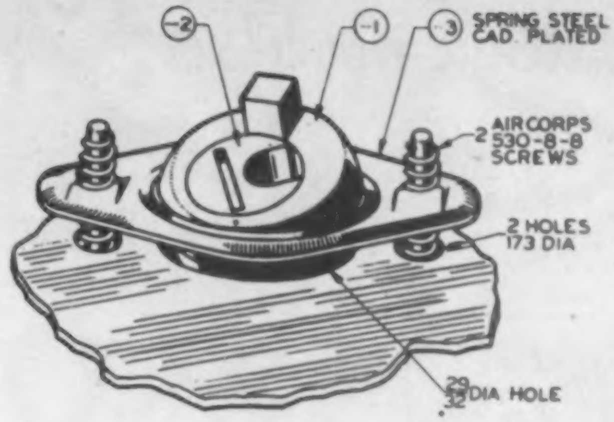

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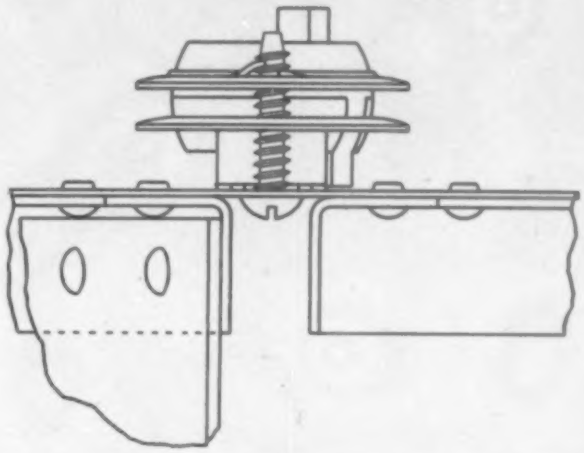

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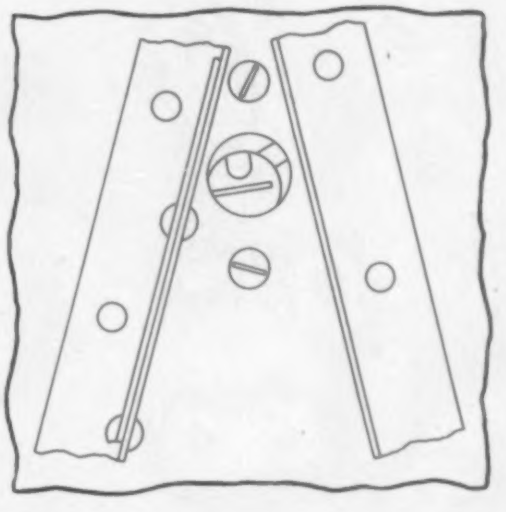

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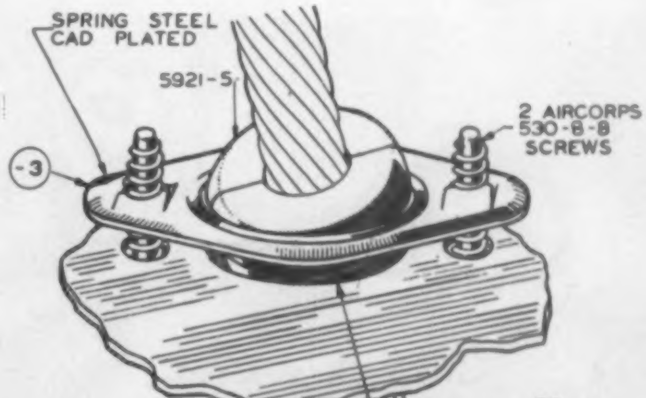
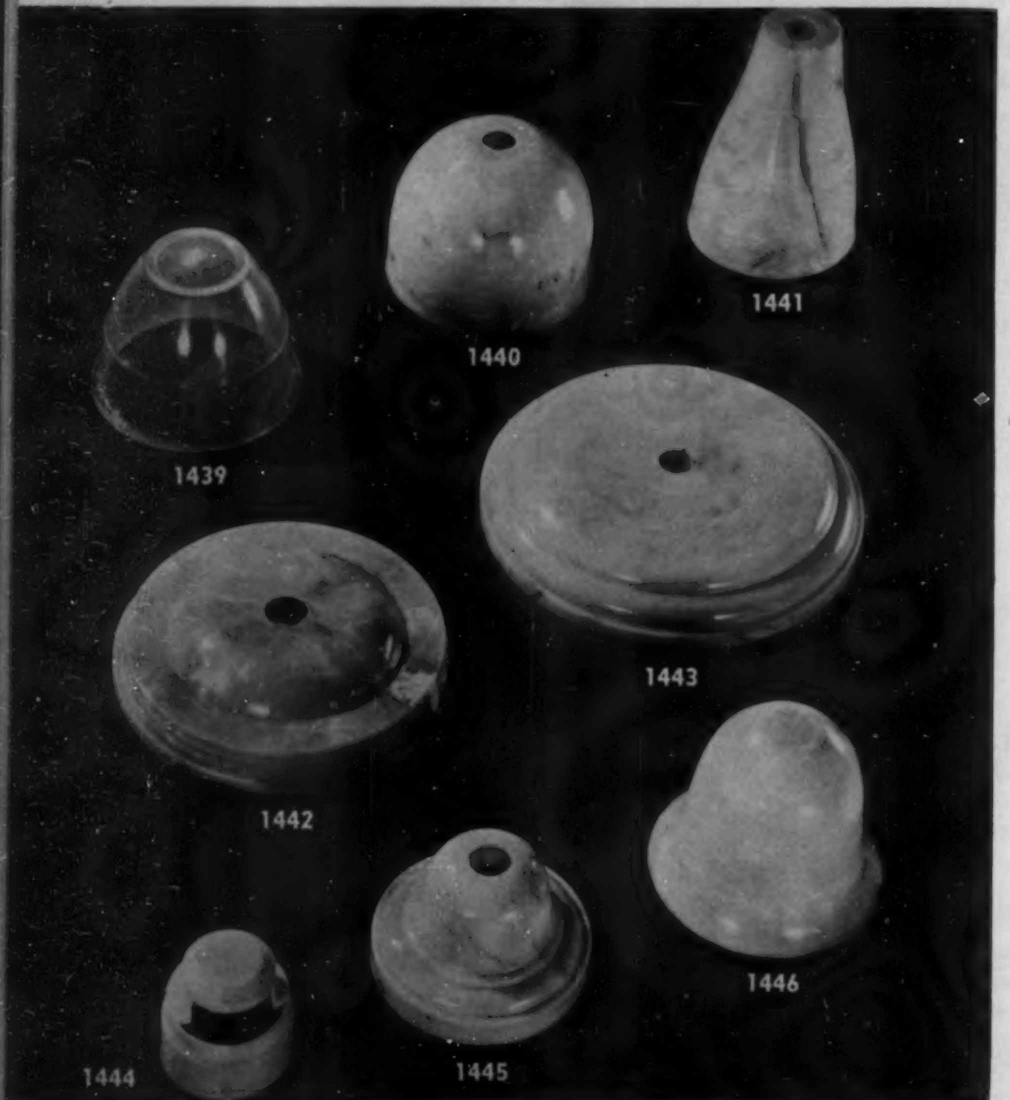


Stock molds

SHEET ONE HUNDRED TWENTY-ONE

Lamp bases, cones, domes, lamp ends, a tiny flower pot and a utility box are available from stock molds without mold cost. Address Modern Plastics, Stock Mold Dept., Chanin Bldg., New York



1439. Transparent flower pot or food mold, with decorative rim. 3 3/8 in. diameter at open end. 1 5/8 in. diameter at closed end. 2 3/4 in. overall height

1440. Dome, 3 1/2 in. overall diameter by 3 1/2 in. overall height. 9/16 in. opening at top. 1 1/4 in. diameter across flat top

1441. Cone, 3 in. overall diameter; 4 1/2 in. overall height; 1 3/8 in. diameter at flat top. 9/16 in. opening at top

1442. Base with raised center and ribbed edge 5 in. in diameter; 1 1/8 in. overall height. 9/16 in. opening

1443. Base 6 in. diameter; 1 1/8 in. overall height. 9/16 in. opening

1444. End for fluorescent lamp fixture. 1 3/4 in. overall diameter; 3/4 in. flat top. Side opening 1/2 in. deep by 1 1/8 in. straight across. 2 in. overall height

1445. Bell-shaped cap, 3 in. overall diameter. 2 in. overall height. 9/16 in. opening

1446. Cone 3 3/16 in. overall diameter. 3 in. overall height. 5/8 in. opening at top

1447. Utility box 4 in. by 5 in. by 1 1/8 in. deep. Black base with hinged ivory cover. Used to hold 2 decks of cards or 2 packages of king size cigarets

Reprints of all stock mold pages which have been published to date, with a complete index of suppliers, are available to Stock Mold Service subscribers

All molders are invited to send samples from stock molds to appear on this page as space permits

Restrictions on supplies of raw materials, etc., may possibly limit production of some of these stock items. Please check molders on quantities available

The long awaited thermoplastics order, M-154—probably one of the most far-reaching in its effect on the plastics industry as a whole—was issued Saturday, June 27, by the Director of Industry Operations, WPB.

Highly indicative of the growing importance of plastics in the war effort, this action, which controls the distribution of thermoplastics, points up the fact that thermoplastics are in great demand for war production, being extensively used in the manufacture of plane and tank parts, gas masks, radios, fire-control instruments, helmets for parachute troops, goggles, ship instruments and a variety of other products.

The order covers thermoplastic synthetic resins and cellulose derivatives. All other types of plastics are already under control. Formaldehyde plastics and derivatives are covered by order M-25 and plastics with elastic qualities are covered by order M-10.

According to the WPB order, war orders are to be filled first and without restrictions and then civilian orders will be considered. The latter are divided into four classifications. The additional provisions, classes and restrictions on deliveries, certifications, etc., will be found in the complete order, which is covered in full below.

TITLE 32—NATIONAL DEFENSE

CHAPTER IX—WAR PRODUCTION BOARD

Subchapter B—Division of Industry Operations

PART 1233—THERMOPLASTICS

GENERAL PREFERENCE ORDER No. M-154

The fulfillment of requirements for the defense of the United States has created a shortage in the supply of Thermoplastics, as hereinafter defined, for defense, for private account and for export; and the following Order is deemed necessary and appropriate in the public interest and to promote the national defense:

SECTION 1233.1—GENERAL PREFERENCE ORDER No. M-154.

(a) *Definitions.* For the purposes of this Order.

(1) "Thermoplastics" means the synthetic resins and cellulose derivatives listed below, whether plasticized or unplasticized, and in all their various forms such as sheets, rods, tubes, shapes, slabs, pellets, powder, solutions, emulsions and flake, but not including yarn or textiles:

(i) Polymers of styrene.

(ii) Polymers of the esters of acrylic and methacrylic acid.

(iii) Polymers of vinyl acetate which have been partially or wholly hydrolyzed and reacted with aldehydes such as formaldehyde, acetaldehyde or butyraldehyde.

(iv) Polymers of vinylidene chloride.

(v) Cellulose acetate-butyrate.

(vi) Cellulose acetate.

(vii) Cellulose nitrate, except that used in explosives and protective coatings.

(viii) Ethyl cellulose (plasticized).

(ix) Monomer and polymers of vinyl acetate.

(x) Nylon.

(xi) Polymers of vinyl alcohol—polymers of vinyl acetate which have been partially or wholly hydrolyzed.

(2) "Producer" means any person engaged in the production of Thermoplastics and includes any person who has Thermoplastics produced for him pursuant to toll agreement, but does not include injection, compression or extrusion molders.

(3) "Class I Uses" means those uses set forth in Exhibit A annexed hereto and made a part hereof.

(4) "Class II Uses" means those uses set forth in Exhibit B annexed hereto and made a part hereof.

(5) "Class III Uses" means those uses set forth in Exhibit C annexed hereto and made a part hereof, except as hereinafter in subparagraph (a) (6) otherwise provided.

(6) "Class IV Uses" means those uses set forth in Exhibit D annexed hereto and made a part hereof, except that until September 1, 1942, such uses shall be considered as Class III Uses.

(7) "Orders for Class I, II and III Uses" mean orders for the uses set forth in subparagraph (a) (3), (4) and (5) hereof exclusive of Defense Orders as defined in Priorities Regulation No. 1, as amended from time to time.

(8) Application should be made to the War Production Board, attention Chemicals Branch, with respect to the classification of uses not mentioned in subparagraphs (a) (3), (4), (5) and (6) hereof.

(9) "15 Day Production Period" shall refer to those periods of the month commencing with the first and fifteenth days thereof and ending with the fourteenth and last days thereof (all days inclusive), respectively.

(b) *Placing of Orders.* No Producer shall accept and no person shall tender an order for delivery of Thermoplastics unless such order is accompanied by a certificate manually signed by the person (or his duly authorized agent) tendering such order containing representations by the person seeking delivery of Thermoplastics:

(1) That delivery of the quantity of Thermoplastics which he seeks will not be in violation of Section 944.8 (Delivery Schedules) or 944.14 (Inventory Restrictions) of Priorities Regulation No. 1, as amended from time to time.

(2) That delivery, during the month in which delivery is sought, of the quantity of Thermoplastics which he seeks will not, together with all quantities received from and on order with other persons for delivery during such month, exceed one-twelfth of the quantity of Thermoplastics consumed by him during the twelve month period ended December 31, 1941.

(3) As to the use (classification to be set forth) to which the Thermoplastics which he seeks will be put, and that the Thermoplastics delivered will be used (except as otherwise provided in paragraph (b) (4)) only for such use.

(4) That scrap resulting from his processing of the Thermoplastics delivered will be used only in accordance with the provisions of subparagraph (e) (2) hereof.

(c) *Compulsory Acceptance of Certain Orders.* In addition to the orders, acceptance of which is compulsory under Priorities Regulation No. 1, as amended from time to time, and subject to the same terms and

conditions applicable thereto, and subject to the provisions of paragraph (b) hereof, orders for delivery of Thermoplastics for Class I, II and III Uses must be accepted by a Producer.

(d) *Scheduling of Production.* Anything in Priorities Regulation No. 1 to the contrary notwithstanding, on the first and fifteenth days of each month commencing with the 15th of July 1942, each Producer shall schedule production (and make delivery) under orders on hand which must be put in process during the then current 15 Day Production Period to meet the delivery dates specified in such orders on such days, respectively, in accordance with the following directions:

(1) Provision shall be made for filling, insofar as possible, Defense Orders in accordance with the applicable provisions of Priorities Regulation No. 1, as amended from time to time.

(2) After provision has been made for filling Defense Orders, provision shall be made for filling, insofar as possible, Orders for Class I Uses. Whenever a Producer will be unable to fill Orders for Class I Uses, all orders for such Uses shall be filled on an equal basis percentage-wise, regardless of preference ratings.

(3) After provision has been made for filling Defense Orders and Orders for Class I Uses, provision shall be made for filling, insofar as possible, Orders for Class II Uses to the extent of 50%, and no more, of each Order. Whenever a Producer will be unable to fill Orders for Class II Uses to the extent of 50%, and no more, of each such Order, all Orders for such Uses shall be filled on an equal basis percentage-wise regardless of preference ratings.

(4) After provision has been made for filling Defense Orders, Orders for Class I Uses and Orders for Class II Uses (to the extent of 50%, and no more), provision shall be made for filling, insofar as possible, the unfilled portion of Orders for Class II Uses and Orders for Class III Uses, the unfilled portion of Orders for Class II Uses and Orders for Class III Uses receiving equal quantities of Thermoplastics, by weight, regardless of preference ratings until Orders for Class II Uses have been filled in toto. Whenever a Producer will be unable to fill the unfilled portion of Orders for Class II Uses or Orders for Class III Uses, the unfilled portion of Orders for Class II Uses shall, as a class, be filled on an equal basis percentage-wise, regardless of preference ratings, and Orders for Class III Uses shall likewise, as a class, be filled on an equal basis percentage-wise, regardless of preference ratings. Provision shall not be made for the filling under this subparagraph (d) (4) of those Orders for Class III Uses which will be filled by the use of scrap as provided in paragraph (e) hereof.

(5) Except as may be otherwise directed by the Director of Industry Operations, no orders shall be put in process except in accordance with the provisions of subparagraphs (d) (1), (2), (3) and (4) hereof.

(e) *Use of Scrap*

(1) Producers may use 100% scrap (built up with the amount of solvent and plasticizer necessary for reprocessing) resulting from the production of Thermoplastics to fill Orders for Class III Uses without regard to the provisions of paragraph (d) hereof, provided that:

(i) Such scrap is not of a quality (excluding considerations of color) to permit it to be used to fill Defense Orders or Orders for Class I or Class II Uses, and

(ii) The quantity of such scrap does not exceed 15% of the Producer's production (estimated for the month in which the scrap is to be used) of the type of Thermoplastic material involved.

(2) Persons obtaining scrap from the processing of Thermoplastic delivered to them may use such scrap for a Use other than that for which the Thermoplastics were delivered (as set forth in the certificate furnished pursuant to the provisions of subparagraph (b) (3)), provided that:

(i) Such scrap is not of quality (excluding considerations of color) to permit it to be used for the Use for which the Thermoplastics from which it was obtained were delivered, and

(ii) The quantity of such scrap does not exceed 15% of the quantity of Thermoplastics from which it was obtained.

(f) *Prohibited Uses*

(1) On and after September 1, 1942, no Producer shall deliver Thermoplastics for Uses set forth in Exhibit D annexed hereto (regardless of preference ratings); provided, however, that deliveries of Thermoplastics for such Uses may be made if the order therefore was received and put in process prior to the effective date of this Order.

(2) On and after September 1, 1942, no person shall use Thermoplastics for Uses set forth in Exhibit D annexed hereto other than the quantities in his inventory prior to the effective date of this Order or the Thermoplastics that may be delivered pursuant to the provisions of subparagraph (f) (1) hereof (regardless of preference ratings).

(g) *Exceptions*

(1) Nothing in paragraph (b) contained shall apply to deliveries to or for the account of:

(i) The Army or Navy of the United States, the United States Maritime Commission, the War Shipping Administration, the Panama Canal, the Coast and Geodetic Survey, the Coast Guard, the Civil Aeronautics Authority, the National Advisory Committee for Aeronautics, the Office of Scientific Research and Development;

(ii) The government of any of the following countries: Belgium, China, Czechoslovakia, Free France, Greece, Iceland, Netherlands, Norway, Poland, Russia, Turkey, United Kingdom including its Dominions, Crown Colonies and Protectorates and Yugoslavia; and

(iii) The government of any country, including those in the Western Hemisphere, pursuant to the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States" (Lend-Lease Act).

(2) Nothing in paragraph (f) contained shall apply to deliveries to or for the account of, or use by, the Army or Navy of the United States or the United States Maritime Commission.

(h) *Effect on Other Orders.* Nothing in this order contained shall be construed to permit the manufacture of any item or of more units of any item listed under Class I, II or III Uses if the manufacture of said item has been prohibited or curtailed by the terms of another Order of the Director of Industry Operations whether heretofore or hereafter issued.

(i) *Reports.* Reports shall be made at such times and on such forms as shall be prescribed therefor by the Chemicals Branch of the War Production Board.

(j) *Violations.* Any person who wilfully violates any provision of this Order, or who, in connection with this Order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States is guilty of a crime, and upon conviction may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using, material under priority control and may be deprived of priorities assistance.

(k) *Appeals.* Any person affected by this Order who considers that compliance therewith would work an exceptional and unreasonable hardship upon him, or that it would result in a degree of unemployment which would be unreasonably disproportionate compared with the amount of Thermoplastics conserved, or that compliance with this Order would disrupt or impair a program of conversion from nondefense to defense work, may appeal to the Director of Industry

Operations by addressing a letter to the War Production Board, Chemicals Branch, Reference M-154, setting forth the pertinent facts and the reason he considers he is entitled to relief. The Director of Industry Operations may thereupon take such action as he deems appropriate.

(l) *Notification of Customers.* Producers of Thermoplastics shall, as soon as practicable, notify each of their regular customers of the requirements of this Order, but the failure to give such notice shall not excuse any such person from complying with the terms thereof.

(m) *Applicability of Priorities Regulation No. 1.* This Order and all transactions affected thereby are subject to the provisions of Priorities Regulation No. 1 (Part 944), as amended from time to time, except to the extent that any provision hereof may be inconsistent therewith, in which case the provisions of this Order shall govern.

(n) *Communications.* Acceptances of this Order, all reports required to be filed hereunder, and all communications concerning this Order shall, unless otherwise directed, be addressed to War Production Board, attention Chemicals Branch, Washington, D. C., Reference M-154.

Issued this 27th day of June, 1942.

J. S. KNOWLSON

Director of Industry Operations

EXHIBIT A

(Class I Uses)

Class I comprises such uses as are essential to the productive effort of the country, such as industrial equipment, transportation, and health. Only functional uses, not readily substituted by more available materials, are included in Class I, and such uses must employ the minimum amount of plastic material required for the functioning of the part. If these requirements are not met, the item shall fall in Class III, even though the end use of the product would normally place it in Class I.

Public Transportation

Commercial aircraft parts and accessories
Railway equipment
Trucks and buses
(1) Safety glass
(2) Control knobs
(3) Lighting equipment
(4) Electrical parts
(5) Other functional parts
Merchant marine applications

Communications

Telephone equipment
Telegraph equipment
Radio parts, except as defined in Class III
Dials
Functional parts
Electrical transcription records and direct cutting records for radio use
Motion picture equipment, professional, including film
Photographic equipment and supplies, professional, including portrait, commercial, and graphic arts, cut films

Industrial Productive Equipment

Battery cases
Belting, transmission
Industrial instruments—crystals, lenses, and other parts
Electrical equipment, e.g., coils and condensers
Refrigerator parts
Industrial tools
Handles for screw drivers and chisels, but not other carpenter tools
Handles for heavy duty factory tools
Oil cans and oil cups
Hammer heads
Sewing machine parts
Identification, supplied by factories to employees
Passes
Buttons
Tags
Pass cases
Functional parts of production machinery
Inspection windows and covers
Sight glasses
Control knobs
Laminated plastic instruction charts for machinery, repair and maintenance, and factory operation
Transparent holders for factory instructions and blue prints
Transparent inventory boxes
Weighing machines
Battery charging equipment
Printing plates

Accessory Equipment for Industrial Plants, Offices, and Commercial Establishments

Lighting fixtures, switches, and parts for electrical distribution
Control panels and parts
Heating equipment parts, e.g., oil burners and thermostats
Insulation
Fan parts (electric)
Air filter and air conditioning equipment
Functional parts for soap dispensers and disinfectant devices
Parts for business machines
Adding machines
Billings and continuous forms handling typewriters
Calculating and computing machines
Dictating machines and collateral equipment, but not including machines embodying amplifiers and other facilities for recording telephone conversations, conferences and wireless messages with near and far voice control
Duplicating machines, including, but not limited to ink ribbon, gelatin, off set, spirit, stencil and reproducing typewriter principle
Microfilm machines
Shorthand writing machines
Time stamp machines
Portable and non-portable typewriters
Accounting and bookkeeping machines
Addressing machines, including, but not limited to embossing machines for plates and stencil cutting machines for fiber stencils
Billing and other forms writing machines, manifolders and collateral equipment (autographic registers not included)
Office composing machines (changeable type, changeable horizontal and vertical spacing, uniform impression)
Pay roll denominating machines and collateral equipment
Punched card tabulating and accounting machines and collateral equipment
Time recording machines, except watchman's clocks
Autographic registers
Cash registers and cash recording machines
Check handling machines
Change making machines
Coin handling machines
Envelope handling machines
Photographic microfilms
Guide cards and visible indexes
Counter scales

Health Supplies for Medical, Surgical, Dental, or Veterinarian Use

Hearing aids (individual type)
Anesthesia, oxygen, and respiratory equipment supplies
Atomizers
Clinical thermometers and cases
Diagnostic equipment and supplies
Hypodermic syringes and needles
Infant incubators
Instruments
Invalid chairs (hand operated), walkers, and crutches
Laboratory equipment and supplies
Operating room supplies and equipment
Optical frames for corrective use only
Physio-therapy equipment and supplies for institutional or professional use
Splints and fracture equipment
Sterilizers
Surgical dressings
Surgical and orthopaedic appliances (including artificial limbs)
Ligatures, sutures, and suture needles
X-ray equipment and supplies, except film
Tooth brushes
Hospital beds, mattresses, and essential bedside equipment
Pessaries
Plastic pipe, connections, and accessories (medical, surgical, dental, and veterinary)
Containers and closures, minimum functional weight, for:
Biologicals, anti-toxine, serums, sterile ampoules and intravenous solutions
Medical chemicals (limited to medical use)
Antiseptics and germicides
Botanical drugs
Hormones and glandular products
Vitamins, including human nutritional use
Preparations for medicinal use, as recommended by the Health Supplies Branch of the War Production Board
Embalming instruments

Food Production and Distribution

Farm implement equipment
Food containers and closures, minimum functional weight
Harness rings, functional
Poultry bands
Identification markers for tubercular cattle

Technical Equipment

Technical instruments
Drawing instruments
Slide rules
Meter wheels
Gauge glasses
Protective covers for instruments
Working models
Materials for scientific research

Safety Equipment

Chemical protective uses
Fire fighting equipment
Industrial safety appliances
Machine and mechanical guards
Gas mask parts
Goggles and shields
Hazard measuring devices
Helmets
Respirators
Flashlights and their parts for industrial use, all types
Flashlight parts, civilian, except all-plastic cases or those with plastic tubes

Housing

Builder's hardware, except as defined in Class III
Counter trim
Domestic heating equipment parts
Blower parts
Thermostat parts and housings
Control buttons
Weather strippings
Plumbing fixtures
Faucet handles
Valve handles
Essential escutcheons
Shower heads
Waste pipes
Electric switches outlets, and escutcheon plates
Lighting fixtures, for permanent installation only

EXHIBIT B

(Class II Uses)

Class II comprises such uses as have been considered essential for the convenience and welfare of the civilian population, such as commercial equipment, household appliances, and essential personal items. Only functional uses, not readily substituted by more available materials, are included in Class II, and such uses must employ the minimum amount of plastic material required for the functioning of the part. If these requirements are not met, the item shall fall in Class III, even though the end use of the product would normally place it in Class II.

Commercial Equipment

- Printing, commercial, and protective covering, except as covered in Class III
- Price tags, sanitary, for meat and dairy products only
- Counter tops and molding
- Cold frames

School and Educational Supplies

- Phonograph records, educational only, including direct cutting records for school use.
- Stereoscopes
- Musical instruments and their functional parts, except as defined in Class III
- Models

Private Transportation

- Passenger automobiles
  - Safety glass
  - Functional parts and accessories, e.g., control knobs and escutcheons
- Bicycle parts
  - Lamp housings
  - Reflector buttons
  - Pedals

Household Appliances and Fixtures

- Refrigerator parts
- Sewing machine parts
- Vacuum cleaner parts
- Carpet sweeper parts
- Washing machine parts
- Stove parts
- Garden sprinklers
- Hose couplings and nozzles

Essential Personal Items

- Combs, essential utility, minimum functional weight
  - Dressing combs
  - Pocket combs
  - Barber and professional combs
  - Plain tuck, back, or side combs
- Hair pins
- Barrettes
- Straight razor handles
- Electric razor housings
- Brushes, minimum functional weight
  - Hair
  - Shaving
- Buttons and buckles, minimum functional weight, utilitarian, non-decorative
- Corset steel covering
- Clothing accessories, essential
- Garter, belt, and suspender parts, except the belting material
- Shoe parts
  - Eyelets
  - Lace tips
  - Box toe
- Umbrella ferrules
- Zippers
- Pipe bits
- Fountain pens
- Ferrules for wood-cased pencils
- Knitting needles
- Crochet hooks
- Watch crystals
- Baby rattles, teething rings, and pacifiers
- Lipstick holders
- Service vanity cases for rouge and powder, not to exceed 1½ in. diameter or 1½ in. sq.
- Religious articles
- Containers for tooth paste, shaving cream, and other personal sanitary use
- Closures, minimum functional weight

EXHIBIT C

(Class III Uses)

Items which are useful, but are either not essential or do not meet the minimum functional weight requirements of Classes I and II.

Commercial Items

- Price tags, other than for meat and dairy products
- Protective envelopes for documents and permanent records
- Vending machines and parts
- Restaurant supplies
- Serving trays
- Stationery supplies
  - Desk sets
  - Pen bases and holders
  - Ink stands
  - Rulers
  - Pocket pencil sharpeners
  - Book and catalog binders and covers
  - Stapling machines
- Beauty parlor equipment
- Barber shop lather dispensers
- Pistol grips
- Containers and closures, not otherwise specified
- Housing items not defined in Class I
  - Door knobs
  - Window lifts
  - Storm sash
- Reflectors, roadside or directional
- Restaurant trays

Household Items

- Clock cases and crystals
- Furniture and furniture parts
- Medical instruments, non-professional
  - Throat lights
  - Tongue depressors
- Chime shields
- Tableware
  - Cups, saucers, plates, and tumblers
- Pocket knives
- Kitchen canister
- Kitchen utensils
  - Measuring cups and spoons
  - Strainers
  - Cooking accessories
- Coin banks
- Window shades
- Chair seats
- Air conditioning unit parts
- Lighting equipment, portable or temporary lamp shades and bases, and light diffusers
- Civilian flashlights, all plastic or those with plastic tubes
- Home, portable, or auto radio receivers
  - Control knobs, dial lenses, and louvres
- Phonograph records, popular and home recording
- Fruit juicers
- Spray closures for disinfectants and insecticides

Personal Items

- Games and toys, dice, and playing cards
- Sporting goods
- Photographic equipment and supplies, amateur, including roll films, film packs, and 8 and 16 mm. reversal films
- Sun goggles, other than those for corrective use
- Visors
- Brushes, novelty or not otherwise specified
- Mechanical pencils
- Billfolds and pass cases
- Hair curlers
- Buttons and buckles, decorative
- Shoe heels, plastic covered
- Handbag frames and handles
- Collar and cuff, including dope for same

EXHIBIT D

(Class IV Uses)

Items which are primarily novelty or ornamental, or definitely non-essential.

Commercial Items

- Soda fountain accessories
- Beverage dispensing accessories
- Displays
- Containers and packages
- Fixtures, mannequins, and hosiery forms, etc.
- Advertising printing
- Signs
- Restaurant and coin-operated phonograph parts
- Amusement machines and parts
- Artificial flowers, florists' supplies, and flower pots
- Caskets, decorative parts
- Thermometer and hygrometer bases and stands
- Massaging machine parts
- Name plates
- Jewelry and watch boxes
- Handles for carpenter tools, other than those defined in Class I

Household Items

- Christmas tree ornaments and Christmas lighting fixtures
- Baby carriage parts
- Musical instruments—decorative parts
- Sculptured pieces
- Table mats, coasters, and table ornaments
- Cutlery boxes
- Closet accessories—shoe horns, shoe trees, clothes hangers
  - Hat boxes
  - Hat stands
- Traveling bags, baggage, and handles therefor
- Curtain fixtures and window shade pulls
- Book ends
- Candle sticks
- Broom fittings and dust pans
- Picture and mirror frames
- Table decorations
- Salt and pepper shakers
- Syphon for carbonated water
- Jigger cups
- Napkin rings
- Bathroom fixtures:
  - Towel bars
  - Soap dishes
  - Toilet seats
  - Laundry hampers
  - Accessories
- Cutlery handles, table and kitchen

Personal Items

- Binoculars and their parts and opera glasses
- Combs:
  - Fancy side, back or tuck combs, using more material than functionally necessary
  - Combs with plastic cases
  - Handle combs
  - Combination combs
  - Combs with attachments
- Glove fasteners
- Cosmetic accessories
- Artificial finger nails
- Smokers supplies
  - Cigarette and cigar holders and cases
  - Pipe cases
  - Ash trays
  - Cigarette boxes
- Razor boxes
- Toilet sets
- Jewelry

Clothing Items

- Shoe heels, all plastic
- Shoe uppers, woven
- Belts, except buckles as otherwise specified
- Gems
- Millinery
- Costume jewelry
- Umbrella handles and tips

Novelties

- Advertising and miscellaneous novelties
- Premium items
- Gadgets

See Washington News, page 98 ff., for analyses of current problems and latest Government orders on plastics.

DR. GORDON M. KLINE, Technical Editor

Temperature vs. strength for phenolics*

by T. S. CARSWELL, D. TELFAIR and R. U. HASLANGER†

A KNOWLEDGE of the effect of temperature on the mechanical properties of molded compositions is becoming increasingly important with the growing demand for plastics in structural uses. Many molded parts for military purposes[1, 2, 3] are going into applications which require that they be serviceable over the temperature range from −51° C. to +71° C. (−60° F. to +160° F.). As a result, specifications are being written by the Army and Navy to cover the mechanical properties of plastics at these temperatures. Requests have recently been received from various divisions of both services for data on this subject. Numerous aircraft manufacturers using plastics in structural applications, as well as the National Advisory Committee for Aeronautics, have expressed a vital need for figures showing the change of mechanical strengths with temperature.

Relatively little significant information on the mechanical properties of plastic materials intended for structural uses has been available in the literature until recently. A publication in 1939 by Jacobi and Thum[4] describes in great detail the physical properties of phenolic compositions at room temperature. Additional information is given in articles by de Bruyne,[5] Melville,[6] Haut[7] and others.[8, 9, 10, 11] In general, these workers have failed to emphasize the importance of changes in temperature on the physical properties under consideration.

Within the last year, Delmonte[12] has reported on the shear strength of molded phenolic materials over a limited temperature range. The variation of flexural strength and the deflection at failure for a number of compression molded plastics at temperatures from −70° C. to +200° C. (−94° F. to +392° F.) is described by Nitsche and Salewski,[13] while a determination of static tensile, compressive, stiffness and bending properties, and fatigue strengths of three laminated phenolic materials at −39, −18 and +25° C. (−38, 0 and +77° F.) are included in Air Corps Technical Report No. 4648.[14] Kistler[15] and Kozlov[16] have also reported on the effect of temperature on the mechanical properties of plastics.

Almost no previous work has been reported on the effect of temperature on the impact strength or of elevated temperature on the tensile strength of molded phenolic compositions. Research work was undertaken to study the change of impact, tensile and flexural strengths over the temperature range from −80° C. to +205° C. (−112° F. to +437° F.). Molded compositions employing woodflour, asbestos, macerated-fabric and cord fillers as well as a pure resin composition were evaluated. Creep properties, shear and compressive strengths for these materials are also being studied over the same temperature range and will be reported at a later date.

The data reported here are short-time temperature effects. The effect of extended conditioning at temperatures other than room temperature, 25° C. (77° F.), has been touched upon briefly by S. W. Place,[17] who studied phenolic laminated materials over a limited temperature range. Committee D-20 of the American Society for Testing Materials has set up a tentative method for determining the permanent effect of heat on plastics. Further work along these lines is extremely important for the evaluation of plastic materials for structural applications.

Preparation of test specimens

Because the physical properties of the molded material depend to a marked degree upon the technique used in the preparation of the materials and test specimens,[18] a knowledge of this technique is essential if the results are to be properly evaluated. The filled materials studied contained 50 percent phenol-aldehyde resin and 50 percent filler, with the exception of the asbestos-filled material which contained 40 percent resin and 60 percent filler. This change was necessary to give a moldable composition. The woodflour-filled and asbestos-filled molding compositions were prepared by rolling the resin and filler on a set of differential rolls in the usual manner for the preparation of general purpose phenolic molding compounds. Three typical phenol-aldehyde resins were evaluated in connection with the woodflour filler:

1. A typical one-stage, basic-catalyzed resin.
2. A typical two-stage, acid-catalyzed resin.
3. A semi-two-stage, dual-catalyzed resin.

No appreciable differences in properties were exhibited over the temperature range, and so the two-stage resin was used with the other fillers and for the preparation of the pure resin molding compound. (*Please turn to next page*)

* This paper was presented at the annual meeting of the American Society for Testing Materials in Atlantic City, N. J., June 23, 1942, and is published here by permission of that Society.

† Plastics Division, Monsanto Chemical Company.

1 T. S. Carswell, Plastics in the Present Emergency, Chemical Industries, February 1941.

2 Campbell, Resinoid Equipment in Wartime, Chem. and Met. Eng. *48*, 90–3 (1941).

3 E. T. McBride, J. B. Lunsford and A. Philipson, Some Views on Plastics in Wartime, Modern Plastics *19*, 39–45, 116, 118 (Apr. 1942).

4 Jacobi and Thum, Mechanische Festigkeit von Phenol-Formaldehyd Kunststoffen, V.D.I. Forschungshief 396 (May/June 1939).

5 N. A. de Bruyne, Plastic Materials for Aircraft Construction, Royal Aeronautical Society Journal *41*, 523–90 (1939).

6 H. W. Melville, Plastics in Industrial Physics, Reports in Progress on Physics, Vol. V (1938).

7 H. N. Haut, Synthetic Resins in Aircraft Construction, Aviation *41*, 84–5, 103, 105, 210, 213–14 (Mar., Apr. 1942).

8 Genung, Long Time Creep of Plastics, Plastics Trends *2*, No. 3, 7 (Feb. 1, 1942).

9 H. Perkuhn, The Creep of Laminated Synthetic Resin Plastics, Translated as Tech. Memo No. 995, N.A.C.A.

10 W. Hofinghof, Plastics in the German Railway System, Kunststoffe *31*, 1–10 (1941).

11 Herbert Chase, Plastics or Metals, British Plastics *13*, 68–71 (1941).

12 J. Delmonte and W. Dewar, Factors Influencing Creep and Cold Flow of Plastics, A.S.T.M. Bulletin No. 112, 35–41 (Oct. 1941).

13 Nitsche and Salewski, Kunststoffe *29*, 209–20 (1939).

14 Oberg, Schwartz and Shinn, Air Corps Technical Report No. 4648, June 6, 1941.

15 S. S. Kistler, The Thermoplastic Behavior of Linear and Three-Dimensional Polymers, J. Applied Physics *11*, 760–78 (1940).

16 P. M. Kozlov, Physical Effect of Temperature on Tensile Strength of Textolite, Trudy Sessii Akad. Nauk. Org. Khim. *1939*, 91–97.

17 S. W. Place, Effect of Heat on Phenolic Laminates, Modern Plastics *18*, 59–62 (Sept. 1940).

18 F. Grush, Impact Resistance as a Function of Cure, Plastics Institute Research Project X-115, Plastics Trends *2*, No. 5, 7 (Mar. 1, 1942).

The high impact materials—macerated-fabric, cord and sisal-fiber fillers—were blended with the resin in a wet mix process. Mixing was held to the minimum necessary to assure a properly blended material in order to prevent disintegration of the filler and assure the maximum strength. The wet resin-filler mix was dried, and the resin polymerized further to give a moldable composition.

Table I gives the molding conditions for the various materials. The variation in the pressure on the 5 by 7 by $^3/_{16}$-in. slabs was necessitated by the variation in the plasticity of the several molding compositions. All specimens were compression molded.

The tensile specimens for all the filled materials were machined from the slabs, following A.S.T.M. method D 638–41T, Type I,[19] except for the 7-in. overall length. The pure resin was molded in a compression mold of the type specified for producing samples according to A.S.T.M. method D 638–41T, Type I. This was necessary, since the 5 by 7 by $^3/_{16}$-in. slab could not be satisfactorily molded and machined of this material.

Impact and flexural test specimens, $^1/_2$ by $^1/_2$ by 5-in. bars, of the pure resin and asbestos- and woodflour-filled materials were molded in a five-bar gang mold.[20] The impact grade materials—cord, sisal-fiber and macerated-fabric filled—were molded in a single bar mold,[21] as is customary for this type of material. Dimensions were held to .512 ± .006 in. on the variable dimension for all specimens.

Testing procedure and equipment

All specimens were conditioned after molding, according to A.S.T.M. method D 618–41T,[22] for 48 hr. at 50° C. ± 3° C., and placed in a desiccator after removal from the oven. Prior to testing, the specimens were conditioned at the desired temperature for from 4 to 5 hours. Tests were run immediately upon removal of the test specimen from the conditioning chamber.

Impact data were obtained on a Tinius-Olsen impact machine with a capacity of 100 inch-pounds ($8^1/_3$ ft.-lb.), and on a Baldwin-Southwark impact tester (developed by the Bell Telephone Laboratories) having a capacity of 4.0 foot-pounds. Tests were run according to A.S.T.M. method D 256–41T,[23] using the notched Izod method in which the stress was applied perpendicular to the direction of the molding pressure.

Tensile and flexural data were obtained on a Tinius-Olsen Universal Tester, a screw-type machine with constant rate of cross-head motion and 10,000-lb. range. The machine was equipped with an insulated housing which enclosed the tensile grips or flexural supports and the specimen. Temperatures from 60° C. to 225° C. (140° F. to 437° F.) were obtained by circulating dry air over heaters enclosed in the cabinet. For temperatures from 25° C. to −80° C. (77° F. to −112° F.) dry air, precooled by contact with solid carbon dioxide, was circulated in the cabinet. Tensile tests were run according to A.S.T.M. method D 638–41T, using the Type I specimen[19] with a thickness of .1875 ± .008 in. Flexural tests were run according to A.S.T.M. method D 650–41T.[24]

Tensile properties

Data showing the change of tensile strength with temperature are given in Table II and are graphically presented in Figs. 1 and 2. The tensile strengths for the filled materials decrease with an increase in temperature over the entire temperature range. Within the limits of experimental error, the three materials, containing organic fillers (woodflour, cord and fabric), have identical strengths at the various temperatures. The asbestos-filled material stands up somewhat better at the higher temperatures and between 160° C. to 200° C. (320° F. to 392° F.) is roughly 25 percent higher in tensile

[19] American Society Testing Materials Standards (1941 Supplement), Part III, Designation: D 638–41T, page 457.
[20] Ibid., Designation: D 647–41T, page 318.
[21] Ibid., Designation: D 647–41T, page 319.
[22] Ibid., Designation: D 618–41T, page 320.
[23] Ibid., Designation: D 256–41T, page 339.
[24] Ibid., Designation: D 650–41T, page 336.

TABLE I.—CONDITIONS USED FOR COMPRESSION MOLDING THE TEST SPECIMENS

Material	*Specific gravity (molded)*	*Specimen*	*Mold temperature*	*Pressure*	*Molding time*
			° C.	*p.s.i.*	*min.*
Woodflour-filled phenolic molding compound	1.35–1.37	A.S.T.M.—5 in. × $^1/_2$ in. × $^1/_2$ in. bar	170	4000	10
		5 in. × 7 in. × $^3/_{16}$ in. slab for A.S.T.M. tensile bar	170	3000	10
Pure phenolic resin compound	.96– .98	A.S.T.M.—5 in. × $^1/_2$ in. × $^1/_2$ in. bar	170	4000	10
		A.S.T.M.—Type I tensile specimen .150 in. thick	170	6200	5—Cure 5—Cool[a]
Asbestos-filled phenolic molding compound	1.94–1.96	A.S.T.M.—5 in. × $^1/_2$ in. × $^1/_2$ in. bar	170	4000	10
		5 in. × 7 in. × $^3/_{16}$ in. slab for A.S.T.M. tensile bar	170	7000	10
Cord-filled phenolic molding compound	1.35–1.37	A.S.T.M.—5 in. × $^1/_2$ in. × $^1/_2$ in. bar	170	4000	10
		5 in. × 7 in. × $^3/_{16}$ in. slab for A.S.T.M. tensile bar	170	7000	15
Fabric-filled phenolic molding compound	1.35–1.37	A.S.T.M.—5 in. × $^1/_2$ in. × $^1/_2$ in. bar	170	4000	10
		5 in. × 7 in. × $^3/_{16}$ in. slab for A.S.T.M. tensile bar	170	7000	15

[a] Because of the difficulty in molding this type of material, the mold was chilled before removing the specimen.

Table II.—Tensile Strength versus Temperature for Molded Phenolic Plastics[a]

Material	Tensile strength of specimens conditioned[b] at: −80° C.	−25° C.	25° C.	80° C.	120° C.	150° C.	230° C.
	p.s.i.	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*
Cord-filled phenolic	6210 ± 610 (n = 5)	6340 ± 330 (n = 5)	6020 ± 400 (n = 5)	4830 ± 510 (n = 5)	4300 ± 500 (n = 5)	4220 ± 400 (n = 4)	3280 ± 300 (n = 5)
Fabric-filled phenolic	6430 ± 340 (n = 8)	6370 ± 230 (n = 8)	6120 ± 260 (n = 7)	6080 ± 180 (n = 10)	4430 ± 220 (n = 9)	3950 ± 400 (n = 5)	
Woodflour-filled phenolic	6280 ± 230 (n = 30)	6490 ± 300 (n = 28)	6100 ± 270 (n = 33)	4770 ± 180 (n = 34)	4430 ± 170 (n = 36)	3750 ± 270 (n = 38)	
Unfilled phenolic resin	5150 ± 600 (n = 4)	5790 ± 1040 (n = 5)	6200 ± 400 (n = 4)	5200 (n = 3)			
Asbestos-filled phenolic	6670 ± 430 (n = 4)	5210 (n = 3)	5570 ± 730 (n = 4)	5500 (n = 2)		5150 (n = 1)	5170 (n = 2)

[a] The number of specimens, n, broken at each temperature is given below each strength figure. The average for the stated number of specimens falls within their given limits 9 times in 10.
[b] All specimens were conditioned for 48 hr. at 50° C., placed in a desiccator, and subjected to the temperatures indicated in the table for 4 to 5 hr. prior to testing.

strength than the other compositions. The pure resin curve is unique in that it shows at 25° C. a maximum value which is about 15 percent above the strength of the woodflour-filled at the same temperature. Above 25° C., the strength of the pure resin falls off until at 80° C. (176° F.) it is the same as the organic-filled compositions. At temperatures below 25° C. the strength drops, and at −80° C. (−112° F.) is about 20 percent of that of the other materials.

Flexural properties

Figures 3 and 4 and Table III present data on the change of flexural strength with temperature. The curves for woodflour-, fabric- and cord-filled molded compositions are parallel and show practically a linear decrease in flexural strength with increasing temperature. The asbestos-filled material also shows a decrease in strength with increasing temperature, but again withstands the higher temperatures better than the organic-filled compositions. The data for flexural strength of the unfilled resin are surprising in two respects: They are higher than expected, about 25 percent above that of the woodflour-filled material, and fall off slightly below 25° C. instead of continuing to increase as do the filled materials.

Impact properties

The effect of temperature on the notched Izod impact strength is given in Table IV and Figs. 5 and 6. For the high impact materials—cord, sisal fiber and macerated fabric—the strength increases with increasing temperature to a critical point and then falls off sharply. The critical point occurs at from 160° C. to 170° C. (320° F. to 338° F.), and is accompanied by charring of the organic filler. The woodflour-filled material exhibits relatively little change of impact strength with temperature up to a critical point at about 160° C. (320° F.), after which the strength falls off sharply. The strengths of the pure resin and asbestos-filled compositions remain practically constant over the temperature range investigated.

Reliability of the test data

The impact values recorded in the attached tables represent the average of from 10 to 20 individual observations. In the case of flexural and tensile values, from 5 to 11 observations were made for each value reported. However, in the running of the tensile tests on the asbestos-filled and pure resin compositions, many of the specimens broke in the grips before the ultimate strength was reached. Consequently, only a few test results were available for many of the conditions reported. These data are, therefore, only preliminary, and are presented here to show the trend of results obtained to date.

The limits within which the observed values may be ex-

Change of the ultimate tensile strength with temperature for: 1—Low impact phenolic molding compositions; 2—Impact grade phenolic molding compositions

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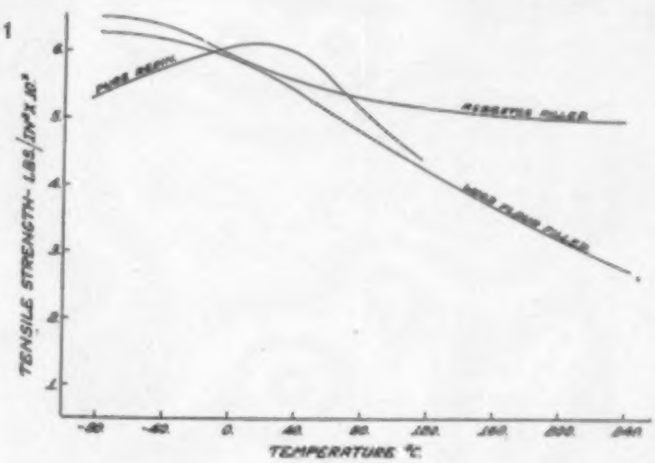

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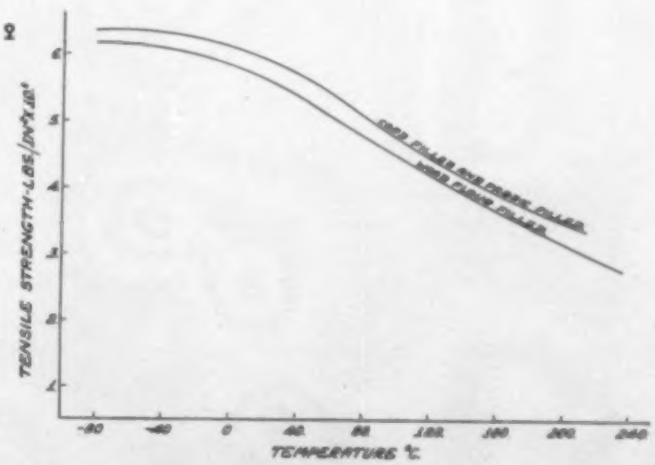

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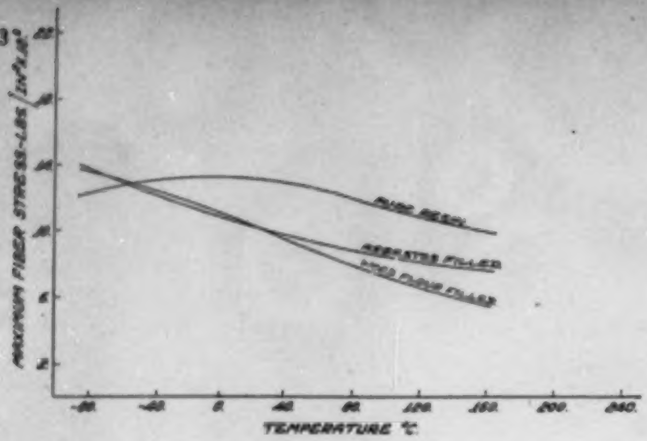

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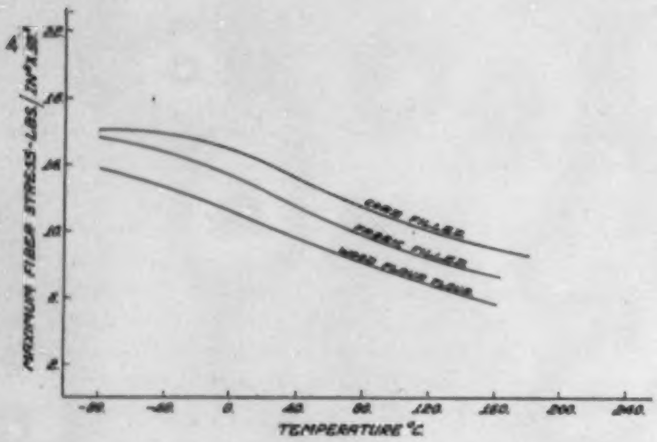

Change of the maximum fiber stress-flexure with temperature for: **3**—*Low impact phenolic molding compositions;* **4**—*Impact grade phenolic molding compositions*

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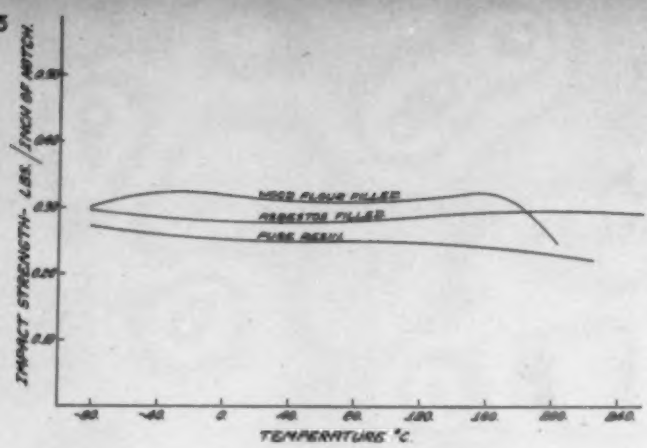

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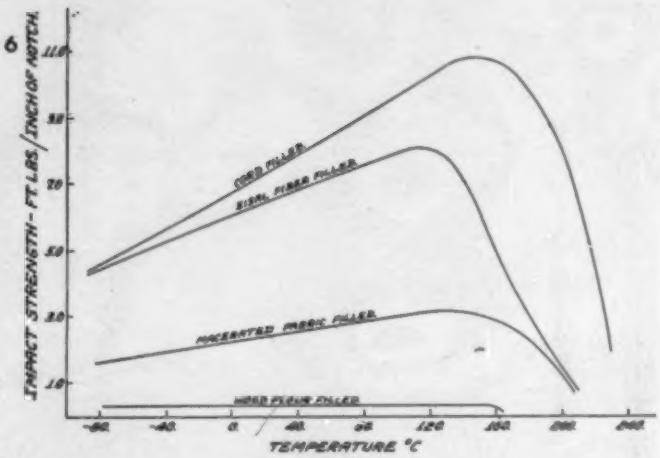


Change of the notched Izod impact strength with temperature for: **5**—*Low impact phenolic molding compositions;* **6**—*Impact grade phenolic molding compositions*

pected to lie 9 times in 10—limits of uncertainty—were calculated according to the A.S.T.M. Manual on Presentation of Data. These limits are included in Tables II, III and IV and are approximately 6 percent for flexural, 4 percent for impact and 5 percent for tensile tests. The percentage variation in strength from batch to batch of the same material is of the same order of magnitude.

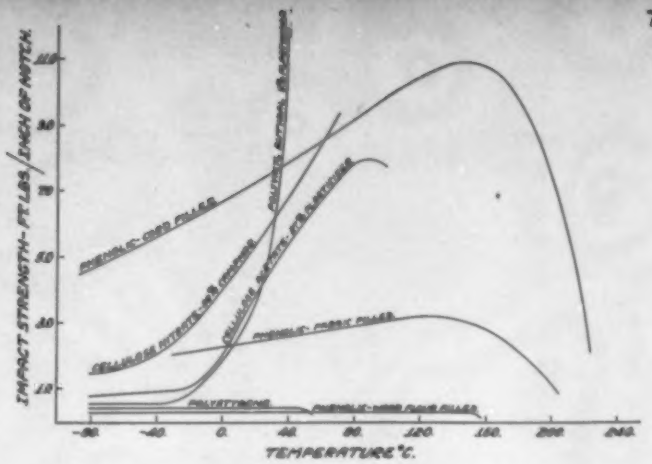
The data presented for the woodflour-filled phenolic are the averages of results on four typical molding compositions, differing only in the basic resin formulation. Results on the individual materials exhibited no appreciable differences in properties over the range investigated.

It should be noted that the notched Izod impact test may be misleading in certain cases where the impact strength of the materials under test is low, and where the specific gravities of different molded materials are substantially different. In low impact materials the energy required to throw the broken end of the test piece becomes a significant portion of the energy expended, and is dependent on the specific gravity of the molded specimen. For example, the asbestos-filled phenolic (specific gravity, 1.95) gives a standard impact value which compares favorably with woodflour-filled molded compositions (specific gravity 1.36) and pure resin compositions (specific gravity, .96). However, the behavior of these materials in machining and general handling indicates that asbestos-filled materials have less shock resistance than the other two.

Table III.—Flexural Strength versus Temperature for Molded Phenolic Plastics[a]

	Flexural strength of specimens conditioned[b] at:						
Material	*−80° C.*	*−25° C.*	*25° C.*	*80° C.*	*120° C.*	*150° C.*	*180° C.*
	p.s.i.	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*
Cord-filled phenolic	15,700 ± 880 (n = 10)	15,900 ± 1800 (n = 7)	12,900 ± 460 (n = 10)	11,800 ± 670 (n = 8)	9720 ± 930 (n = 8)	9200 ± 700 (n = 7)	8560 ± 730 (n = 7)
Fabric-filled phenolic	14,800 ± 730 (n = 10)	12,400 ± 540 (n = 8)	12,000 ± 570 (n = 10)	9500 ± 450 (n = 10)	8010 ± 400 (n = 10)	7330 ± 700 (n = 10)	
Woodflour-filled phenolic	13,100 ± 650 (n = 40)	11,700 ± 550 (n = 40)	9770 ± 460 (n = 40)	7880 ± 550 (n = 40)	6200 ± 530 (n = 40)	5380 ± 620 (n = 40)	
Unfilled phenolic resin	12,300 ± 890 (n = 10)	12,400 ± 950 (n = 10)	13,300 ± 960 (n = 10)	12,300 ± 880 (n = 9)	10,500 ± 980 (n = 8)	10,000 ± 820 (n = 8)	
Asbestos-filled phenolic	13,700 ± 600 (n = 10)	11,900 ± 640 (n = 10)	10,200 ± 670 (n = 10)	9320 ± 770 (n = 10)	8580 ± 330 (n = 10)	7260 ± 780 (n = 10)	

[a] The number of specimens, n, broken at each temperature is given below each strength figure. The average for the stated number of specimens falls within their given limits 9 times in 10.
[b] All specimens were conditioned for 48 hr. at 50° C., placed in a desiccator, and subjected to the temperatures indicated in the table for 4 to 5 hr. prior to testing.



7—*Change of impact strength with temperature for various plastic materials*

Practical significance of the test data

Over the temperature range of normal use, −51° C. to +71° C. (−60° F. to +160° F.), the mechanical strengths of phenolic molding compositions deviate from the value at 25° C. (77° F.) by about ±15 percent. The tensile and flexural strengths show a decrease with increasing temperature. This is offset in the high-impact materials by an increase in impact strength with increasing temperatures.

Tensile properties are practically independent of the filler used. The use of cord- or macerated-fabric, high-impact fillers improves the flexural strengths slightly over the temperature range. Impact strengths may be greatly increased over the entire temperature range by use of fibrous fillers such as macerated fabric, sisal fiber, cord, etc.[25, 26]

The outstanding value of thermosetting materials as compared to thermoplastics lies in the relatively slight effect of temperature on mechanical properties of the phenol-aldehyde resins. This is well illustrated in Fig. 7, which shows the change in impact strength with temperature for various plastic materials.[27, 28] Comparing the woodflour-filled phenolic composition with injection-molded polystyrene, it may be seen that the critical point is roughly 100 degrees C. (212 degrees F.) higher for the phenolic. The maximum temperature of serviceability for thermoplastics ranges from 40 °C. (104° F.) for polyvinyl butyral containing 9 percent plasticizer to 90° C. (194° F.) for cellulose acetate containing 27 percent plasticizer. The high-impact phenolic materials are serviceable at temperatures as high as 160° C. to 170° C. (320° F. to 338° F.). At temperatures below 25° C. (77° F.) the impact strengths of cellulose acetate, cellulose nitrate and polyvinyl butyral fall off sharply, giving values less than 50 percent that of the cord-filled phenolic.

It must be emphasized that the data presented are strictly and necessarily of an empirical nature. For comparative results, a number of mechanical properties have been determined by standard A.S.T.M. methods on standard approved specimens. The results obtained give data for similar material tested under identical conditions. It is often difficult to use the actual numerical values in evaluating a specific material for a particular application, but these values do serve as a basis for selecting the most suitable material. Since the form factor, mold design, molding conditions, treatment following molding and numerous other factors affect the strength of the molded article, the final evaluation of the material should be based on actual service tests on the finished product.

Molded phenolic compositions, particularly those of the higher impact type, possess mechanical properties which make them practical for use in structural applications.

[25] Whitlock and Haslanger, High Impact Molding Compounds, Modern Plastics, June 1942, 70–1.
[26] V. Meharg, Why Fillers in Thermosetting Molding Materials, Modern Plastics *15*, 46–54 (Oct. 1937).
[27] Carswell, Hayes and Nason, Physical Properties of Polystyrene as Influenced by Temperature, Ind. Eng. Chem. *34*, 454–7 (1942).
[28] T. S. Lawton, Unpublished Data, Plastics Division, Monsanto Chem. Co.

TABLE IV.—IMPACT STRENGTH VERSUS TEMPERATURE FOR MOLDED PHENOLIC PLASTICS[a]

Material	Impact strength of specimens conditioned[b] at: −80° C.	−25° C.	25° C.	80° C.	120° C.	150° C.	170° C.	200° C.	220° C.	250° C.
	ft.-lb./in. of notch	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*
Cord-filled phenolic	4.85 ± .35 (n = 18)	5.50 ± .43 (n = 18)	7.21 ± .42 (n = 20)	8.57 ± .64 (n = 18)	10.05 ± .56 (n = 18)	11.1 ± .46 (n = 18)	9.94 ± .61 (n = 18)	10.6 ± .51 (n = 18)	2.47 ± 2.1 (n = 18)	
Fabric-filled phenolic	1.61 ± .12 (n = 10)	2.01 ± .22 (n = 10)	2.37 ± .28 (n = 10)	2.95 ± .23 (n = 10)	3.11 ± .25 (n = 10)	3.08 ± .24 (n = 10)	2.68 ± .40 (n = 10)	.99 ± .21 (n = 10)		
Woodflour-filled phenolic	.29 ± .006 (n = 80)	.32 ± .010 (n = 80)	.31 ± .016 (n = 80)	.31 ± .006 (n = 80)	.32 ± .006 (n = 80)	.33 ± .006 (n = 80)	.31 ± .02 (n = 80)	.25 ± .02 (n = 80)		
Unfilled phenolic resin	.269 ± .005 (n = 12)	.260 ± .02 (n = 12)	.248 ± .01 (n = 12)	.233 ± .01 (n = 20)	.224 ± .01 (n = 17)	.225 ± .01 (n = 19)	.230 ± .01 (n = 18)			.222 ± .01 (n = 18)
Asbestos-filled phenolic	.300 ± .006 (n = 18)	.278 ± .006 (n = 18)	.284 ± .01 (n = 16)	.283 ± .008 (n = 16)	.282 ± .01 (n = 16)		.293 ± .01 (n = 16)	.288 ± .02 (n = 8)		.286 ± .01 (n = 16)

a The number of specimens, n, broken at each temperature is given below each strength figure. The average for the stated number of specimens falls within their given limits 9 times in 10.
b All specimens were conditioned for 48 hr. at 50° C., placed in a desiccator, and subjected to the temperatures indicated in the table for 4 to 5 hr. prior to testing.

Bearing strength: plastics and plywood*

by JAMES BOND†

PLASTICS are being used today in many and varied applications but as yet few actual design data as to their physical characteristics are available. It was with this in mind that the problem of the method of the determination of the bearing strength of several reinforced plastics was undertaken. The test methods discussed in this paper are applicable to all types of plastics.

Materials and apparatus

The test specimens used in these tests were prepared from sheets of six different types of commercially available plastics, namely: Laminated-canvas phenolic plastic $^1/_2$ in. thick; molded macerated-filled phenolic plastic $^9/_{16}$ in. thick; laminated-paper phenolic plastic, grade XX, $^1/_2$ in. thick; 3-ply birch plywood 0.11 in. thick made with $^1/_{30}$-in. thick veneers; 7-ply birch plywood 0.14 in. thick made with $^1/_{48}$-in. thick veneers and 27-ply birch plywood $^1/_2$ in. thick made with $^1/_{48}$-in. thick veneers. The plywoods were bonded with phenolic resin film. Henceforth in this paper these materials will be referred to as canvas, macerated, XX, 3-ply, 7-ply and 27-ply, respectively.

The specimens were cut to size with an ordinary hollow-ground circular saw and the bearing hole, which was $^3/_8$ in. in diameter, was drilled and reamed to size. Care was taken to avoid charring the material while drilling in order that true results could be obtained from the tests. The plywood specimens were cut to a size of $1^1/_4$ in. by $1^1/_8$ in. and, in the case of the 3-ply and 7-ply specimens, enough sheets were stacked together to give an approximate thickness of $^1/_2$ in. The other three specimens were cut to a size of $1^3/_8$ in. by $1^1/_8$ in. This slight increase in size was made in order to make sure that the specimen would fail in bearing rather than in some other manner.

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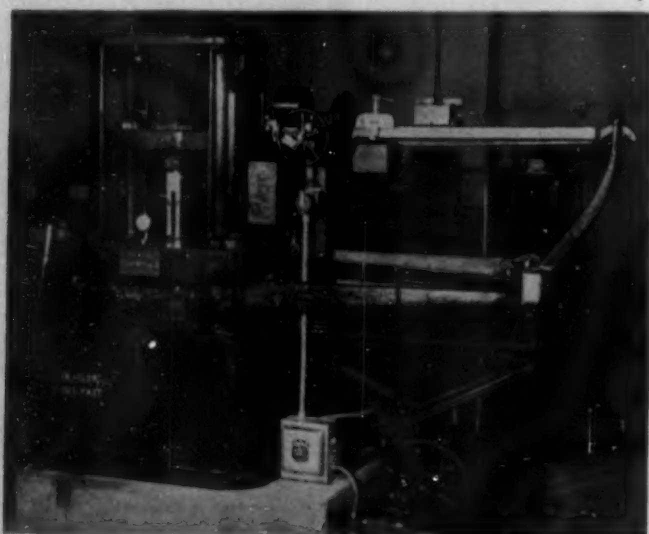

1—*Testing machine used in making bearing strength tests*

The specimens were conditioned in three different ways. One set of specimens was placed in a desiccator over a saturated solution of calcium nitrate. This solution maintained a relative humidity of approximately 55 percent in the desiccator. Another set of specimens was immersed in water at a room temperature of approximately 70° F. The third set of specimens was placed in a drying oven which was maintained at a temperature of 160° F. All specimens were allowed to remain in their conditioning medium for a period of at least 96 hr. before any testing was done. The specimens were tested immediately upon removal from the conditioning medium. The tests required approximately 10 to 15 min. for completion.

The testing was done in a Riehle 40,000-lb. testing machine (Fig. 1) at room temperature and the loads were applied and removed at a rate of 0.0529 in. per minute. The specimens were placed in a jig (Fig. 2) which is similar to the one proposed for this type of testing by the Glenn L. Martin Co. This jig consists essentially of two heavy metal plates separated by two spacer blocks. A plunger slides between the spacer blocks and impinges upon the top of the test specimen. This test specimen is held in place by a bearing pin which runs through the side plates and the specimen, and is constructed of $^3/_8$-in. ground and polished drill rod. In this jig, the part of the specimen above the bearing pin is compression loaded when a force is applied to the plunger. The part of the specimen below the bearing pin is essentially unstressed and the deformation due to bearing pressure is measured at this point through the use of a multiplying lever. The multiplying lever has two purposes: it places the Ames dial gage in a more convenient place for reading, and it also multiplies the deformation so that less error will be made in reading small deformations. The multiplying lever used in these tests was 5 in. long. Through the use of this lever readings may be made directly to $^2/_{10,000}$ in. Deflections were not measured until the rapid initial deformation had occurred in the test specimens (0.5 to 1 min.). The test jig was accurately centered between the crossheads of the testing machine so that the load would not be applied eccentrically.

Load versus deformation test

The United States Army Air Corps has proposed a test to determine the bearing strength of plastic materials.[1] In this test, the maximum allowable bearing load is to be that load which causes a deformation in the plastic equal to 4 percent of the diameter of the bearing pin. This test can be performed quite easily with the jig previously described. A load is placed on the specimen and the deformation is noted when the machine is balanced. A series of readings was taken from zero loading up to a loading which gave a deformation in the specimen equal to approximately 7 percent of the bearing-pin diameter.

The test was run using specimens prepared as previously noted. The tabulated results for the bearing load at the loading which gave a deformation equal to 4 percent of the diameter of the bearing pin appear in Table I. Eight specimens

* This paper was presented before the Rubber and Plastics Subdivision of the American Society of Mechanical Engineers at Cleveland, Ohio, on June 8, 1942, and is published here through the courtesy of that Society.

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[1] Modern Plastics 19, 214 (Nov. 1941).

Table I.—Bearing Strength Tests: Load versus Deformation

Material	*Load causing a deformation equal to 4 percent of the bearing pin diameter on specimens conditioned for 96 hr. at:* 160° F.	70° F. and 55% R.H.	70° F. in water
	p.s.i.	*p.s.i.*	*p. s.i.*
Canvas	32,900	32,900	26,300
Macerated	31,800	26,900	25,900
XX	36,200	33,100	26,600
27-ply	15,400	9,500	4,500
7-ply	16,500	12,500	5,600
3-ply	9,100	8,100	3,800

of each material were tested for the 55 percent conditioning treatment and the data were averaged to obtain the curves shown in Fig. 3. Four specimens were used for the conditioning treatment at 160° F. and for the water immersion, and the data averaged to obtain the curves shown in Figs. 4 and 5.

Load versus permanent set test

A test for determining the bearing strength of plastics has been proposed in which the maximum allowable bearing load is to be that load which causes a permanent set in the material equal to 0.2 percent of the bearing pin diameter.[2] For plastic materials which do not have a well-defined yield point, an arbitrary index of elastic strength must be chosen which takes into account the amount of permanent deformation a material can have without appreciable structural damage. For other materials not having a well-defined yield point, a limiting set of 0.2 percent has been found satisfactory for locating the yield strength. Therefore it seemed logical to assume a limiting value of 0.2 percent permanent set in determining the applied bearing stress of structural thermosetting plastics.

In this test, the specimen was loaded to about 10 percent of the maximum bearing load as determined by a preliminary test, the load and deformation were recorded and the load was then removed at the same rate at which it was applied until zero loading was reached. The deformation at zero loading was recorded as the permanent set for that loading. A series of these tests was run from zero loading up to a loading which give a permanent set to the specimen of approximately 2 per cent of the diameter of the bearing pin. The test specimens were conditioned as previously noted. The tabulated results for the bearing load at that loading which causes a permanent set equal to 0.2 percent of the diameter of the bearing pin are indicated in Table II. Average curves of load versus permanent set were plotted for all six types of material conditioned in the three different ways, using 4 to 8 specimens for each condition as in the deformation tests. They appear in Figs. 6 to 8, inclusive.

Discussion of results

The unit bearing pressure for both tests was determined from the formula $S_b = P/1.57rl$, in which S_b equals the unit bearing pressure in pounds per unit area, P equals the applied force in pounds, r equals the radius of the bearing hole and l equals the thickness of the specimen.[3] The formula is evolved assuming that the radial pressure distribution varies as a cosine curve with the pressure equal to zero at the sides of the bearing hole and a maximum at the center. If the radial pressure had been assumed constant the formula would have become $S_b = P/2rl$. This last equation is used in practice because of its simplicity, but the first equation represents a better approximation of the true unit bearing pressure.

Load versus deformation. In the test as proposed by the Army Air Corps, heating at 160° F. for 96 hr. increased the bearing strength of the specimens and soaking in water at 70° F. for 96 hr. decreased their bearing strength, as compared to the strength of those specimens conditioned at room temperature and 55 percent relative humidity. The bearing strength in this test is equal to the loading required to cause a deformation in the specimen equal to 4 percent of the diameter of the bearing pin.

The canvas and XX products had the greatest bearing strength of the materials that were tested and were followed closely by the macerated material. The plywoods were definitely inferior to the reinforced plastics of higher resin content. The bearing strength of the plywoods in the dry condition (heated at 160° F.) was approximately 3 times as great as that observed for the same materials in the wet condition. The 7-ply product had the highest bearing strength of the group of plywoods. Its superiority to the 27-ply product which was made with the same thickness of veneer ($^1/_{43}$ in.) and same resin film can possibly be attributed to less complete curing of the resin in the thicker material. The lower bearing strength of the 3-ply product can be explained on the basis of the lower resin content of this plywood which was made with $^1/_{24}$-in. veneer.

Load versus permanent set. In the load versus permanent set test, the proposed limiting value of permanent set, 0.2 percent of the pin diameter, amounted to only 0.00075 inch or a dial reading of 3.75 divisions. This means that in order for a test to be run with any degree of accuracy the gage which measures deflection must have no lost motion. The type of dial gage used gives accurate readings when the dial readings are increasing but when the readings start to decrease they cannot be assumed to be entirely accurate due to the inherent lost motion in reversing the direction. It would seem logical

2—Jig for determination of bearing strength

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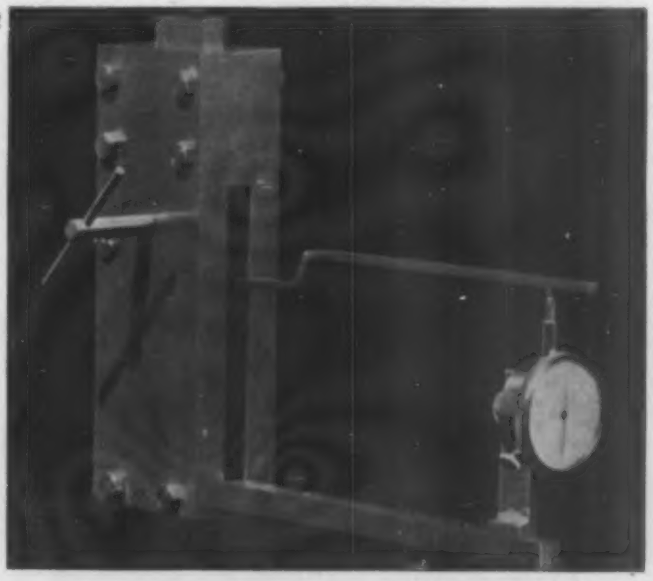
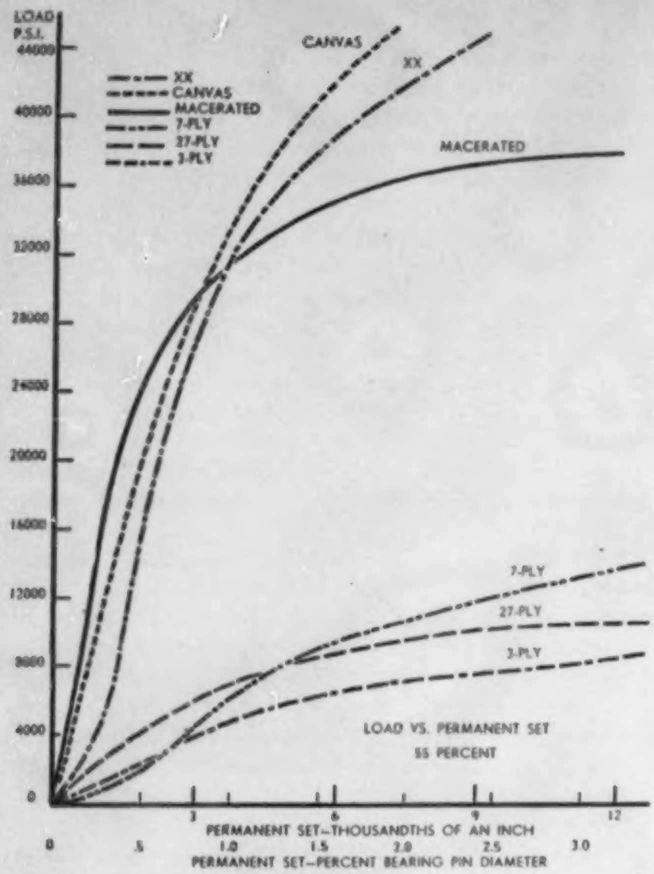


[2] "Proposed Specifications for Structural Thermosetting Plastics," Glenn L. Martin Co. Engineering Report No. 1432 (Apr. 1941).
[3] Riggs and Frocht, "Strength of Materials," New York, Ronald Press, page 55.



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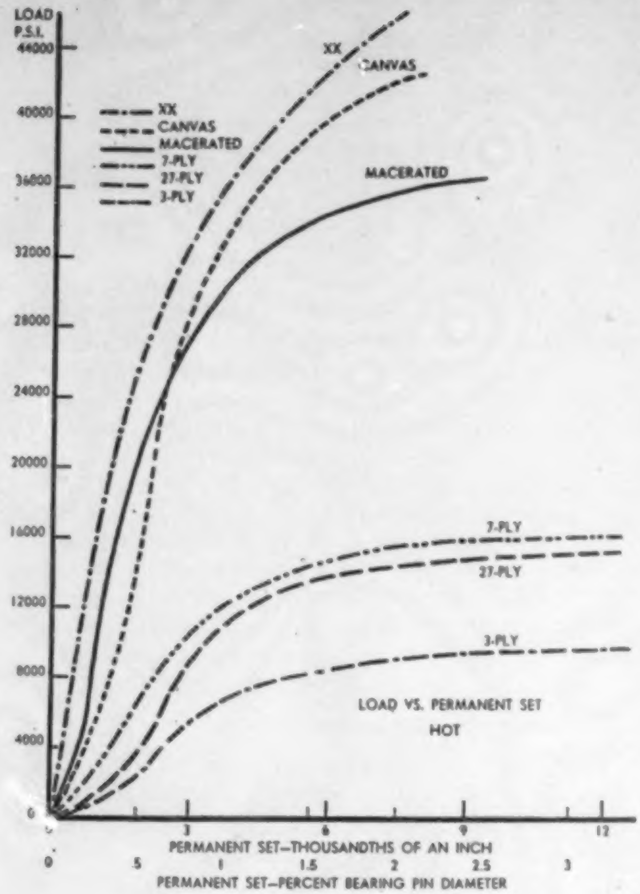

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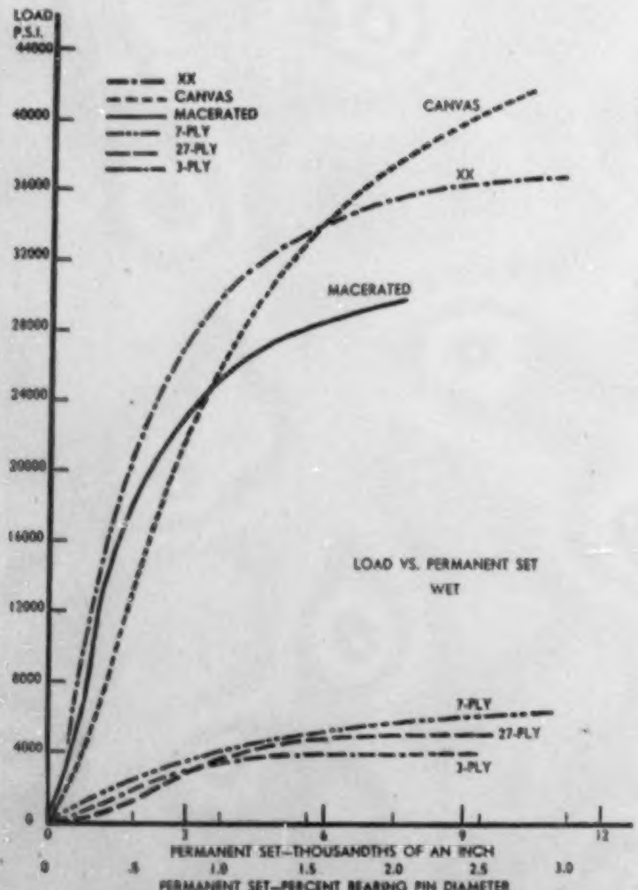

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to assume that there is considerable error in determining a permanent set as small as 0.2 percent because of failure of both instrument and specimens to respond in a reproducible way. It is therefore believed that no conclusions can be drawn from the erratic results shown in Table II.

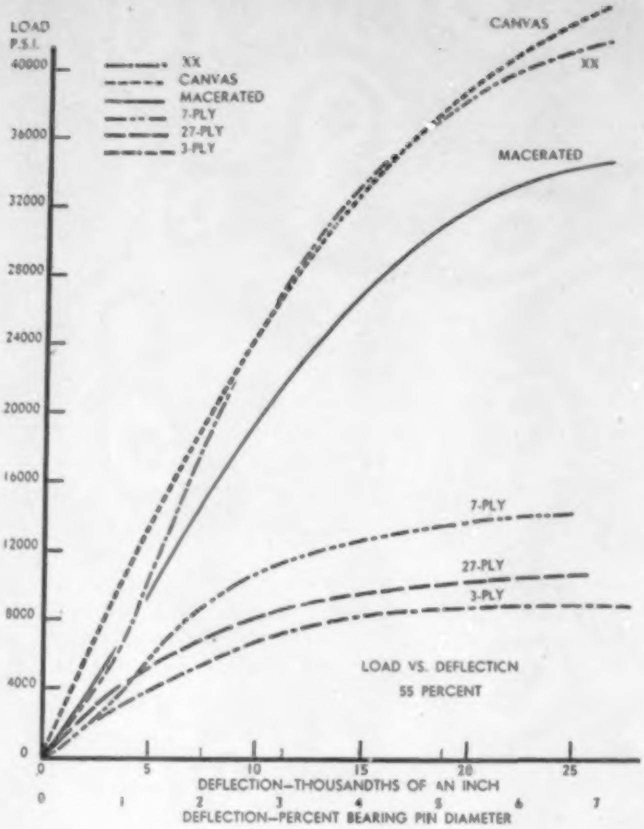
In order to get allowable unit pressures comparable to those as found by the load versus deformation test, permanent sets up to 3 percent of the bearing pin diameter were encountered with an average value of about 1.6 percent. Bearing loads which give a permanent set of 1.6 percent have been read from the curves in Figs. 6 to 8 and are shown in Table III. These data are in agreement with the conclusions derived from the deformation data.

Summary

The specimens used in these tests were representative of commercially available high-impact molded and laminated

TABLE II.—BEARING STRENGTH TESTS: LOAD VERSUS PERMANENT SET (0.2 %)

Material	*Load causing a permanent set equal to 0.2 percent of the bearing pin diameter on specimens conditioned for 96 hr. at:* 160° F.	70° F. and 55% R.H.	70° F. in water
	p.s.i.	*p.s.i.*	*p.s.i.*
Canvas	4,100	8,100	4,200
Macerated	5,700	10,700	6,900
XX	12,600	3,100	9,300
27-ply	1,000	1,900	300
7-ply	2,100	500	1,100
3-ply	600	700	500



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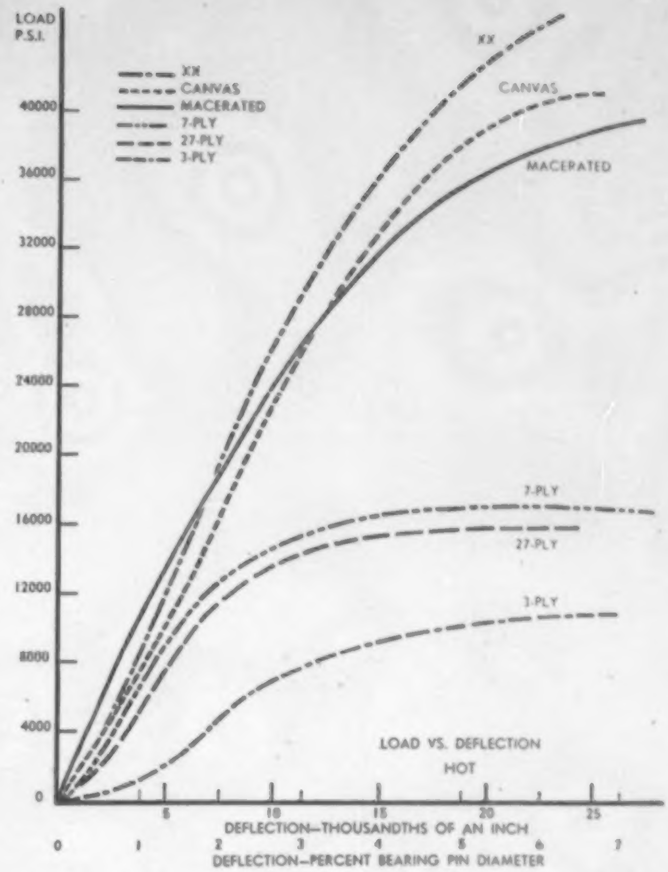

7

plastic sheets and resin-bonded birch plywood. The testing was done in a jig similar to that proposed by the Glenn L. Martin Co. for making bearing tests on sheet plastics. Two main types of test were run: load versus deformation and load versus permanent set. Curves were plotted for load versus deformation in percent of bearing pin diameter, and load versus permanent set in percent of bearing pin diameter.

Three sets of test specimens were used: One set was conditioned in a desiccator at 55 percent relative humidity for 96 hr.; one set was immersed in water at room temperature of approximately 70° F. for 96 hr.; and one set was placed in a drying oven in which the temperature was maintained at approximately 160° F. for 96 hr. The main tests were done at 55 percent relative humidity, and the other two tests were run to determine the effect of extremes in temperature and moisture upon the bearing strength of the specimen.

(*Please turn to page 110*)

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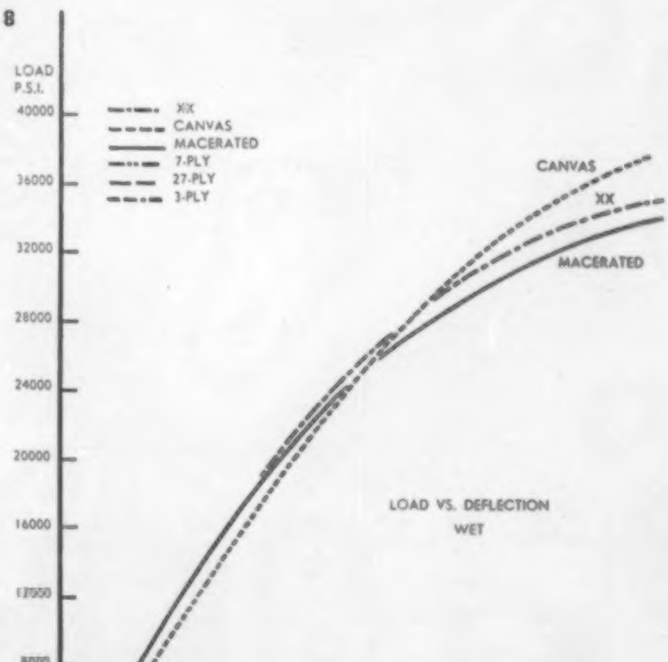


TABLE III—BEARING STRENGTH TESTS: LOAD VERSUS PERMANENT SET (1.6 %)

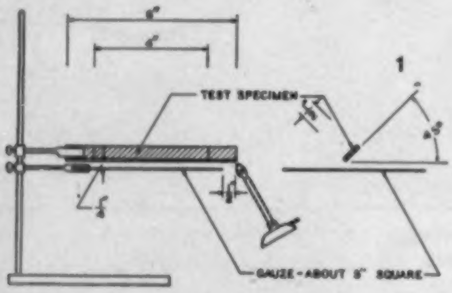
Material	*Load causing a permanent set equal to 1.6 percent of the bearing pin diameter on specimens conditioned for 96 hr. at:* 160° F.	70° F. and 55% R.H.	70° F. in water
	p.s.i.	*p.s.i.*	*p.s.i.*
Canvas	40,000	42,300	34,500
Macerated	34,500	35,200	28,600
XX	42,600	39,000	34,200
27-ply	13,800	8,800	4,800
7-ply	14,700	9,400	5,200
3-ply	8,500	6,400	3,900

Test for flammability of plastics*

Scope

1. This method of test covers the procedure for determining the flammability of plastics in the form of sheets or plates over 0.050 in. in thickness.

NOTE. For tests of plastics in the form of thin sheets or films 0.050 in. and under in thickness reference should be made to the Tentative Method of Test for Flammability of Plastics 0.050 in. and Under in Thickness (A.S.T.M. designation D 568) of the American Society for Testing Materials.[1] Flammability tests of sheet and plate insulation are covered in the Standard Methods of Testing Sheet and Plate Materials Used in Electrical Insulation (A.S.T.M. designation D 229) of the American Society for Testing Materials.[2]



1—*Apparatus for flammability test*

Apparatus

2. The apparatus shall consist of the following:

(*a*) *Test chamber.* A room or enclosure protected from air currents, but provided with means for venting the fumes from burning specimens. A hood may be used if its exhaust fan is turned off during the test and allowed to run only periodically to clear out the fumes between tests.

(*b*) *Ring stand.* A laboratory ring stand with two clamps.

(*c*) *Burner.* A bunsen burner or an alcohol lamp.

(*d*) *Wire gauze.* A piece of 20-mesh wire gauze, 5 in. square.

(*e*) *Stop watch.*

* This tentative method of test for flammability of plastics over 0.050 in. in thickness, A.S.T.M. designation D 635–41 T, is published here by permission of the American Society for Testing Materials.

Test specimens

3. (*a*) At least three test specimens 6 in. in length by 0.5 in. in width and of the thickness of the material as normally supplied shall be cut from each of the materials being tested. The specimens shall be tested in the as-received condition. Special preconditioning may be agreed upon by the purchaser and the seller.

(*b*) Each test specimen shall be marked by scribing two lines 1 in. and 4 in. from one end of the specimen.

Procedure

4. (*a*) The specimen shall be clamped in a support, at the end farthest from the 1-in. mark, with its longitudinal axis horizontal and its transverse axis inclined at 45 deg. to the horizontal. Under the test specimen there shall be clamped a piece of 20-mesh bunsen burner gauze about 5 in. square, in a horizontal position 1/4 in. below the edge of the specimen, and with about 1/2 in. of the specimen extending beyond the edge of the gauze (see Fig. 1).

(*b*) A bunsen burner or an alcohol lamp with a flame 1/2 to 3/4 in. in height shall be placed under the free end of the test specimen and adjusted so that the flame tip is just in contact with the specimen. At the end of 30 sec. the flame shall be removed and the specimen allowed to burn. A stop watch shall be started when the flame reaches the first mark, 1 in. from the end, and the time observed when the flame reaches the 4-in. mark. In case the plastic does not continue to burn after the first ignition, the burner shall be placed under the free end for a second period of 30 sec. immediately following the extinction of the flame. If the sample does not continue burning to the 4-in. mark after the second ignition, the sample shall be reported as self-extinguishing.

Report

5. The report shall include the following:

(1) The thickness of the material,
(2) Number of ignitions used, and
(3) Rate of burning in inches per minute, average of three tests.

[1] 1941 Supplement to Book of A.S.T.M. Standards, Part III, p. 444.
[2] 1939 Book of A.S.T.M. Standards, Part III, p. 265.

Plastics statistics for 1941 would normally appear in this issue of MODERN PLASTICS. However, the preliminary report of the United States Tariff Commission on the production and sales of synthetic organic chemicals has been delayed this year because of the war. When the report is released we will present our usual summary of statistics applicable to the synthetic resins, cellulose plastics and plasticizers. Attention of the reader is directed to the 1941 production figures reported on pages 90 and 92 of the February 1942 issue of MODERN PLASTICS.

Selected for Service

Tenite parts for blood-pressure instruments molded by Bridgeport Moulded Products, Inc. for W. A. Baum Co., Inc.

Tenite is chosen to replace brass in the manufacture of air-flow control units for blood-pressure instruments.

Molded by rapid injection, the Tenite parts can be produced in the time and quantities required to meet new Army, Navy, and civilian demands. They are about 75% lighter in weight than similar brass parts—an important factor in portable medical equipment.

Tenite has excellent dimensional stability and durability under varying climatic conditions. It is the prescribed material for many types of precision instruments which must perform efficient service under the most adverse conditions. Literature on Tenite and its uses will be supplied upon request.

TENITE REPRESENTATIVES: *New York*, 10 East 40th Street. *Buffalo*, 1508 Rand Building. *Chicago*, 1564 Builders' Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Massachusetts*, 39 Main St. *Washington, D. C.*, 1125 Earle Building . . . Pacific Coast: Wilson & Geo. Meyer & Company—*San Francisco*, 15th Floor, 333 Montgomery St.; *Los Angeles*, 2461 Hunter St.; *Seattle*, 1020 4th Ave., South.

Tenite an Eastman plastic

TENNESSEE EASTMAN CORPORATION
Subsidiary of Eastman Kodak Company
KINGSPORT, TENNESSEE

Plastics digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to individual publishers

General

FURTHER INFORMATION ON THE PLASTICIZING OF WOOD. Forest Products Laboratory. Wood Products *46*, No. 11, 19–20, 22 (1941). Green wood is plasticized by soaking in urea solution and drying. The product which is readily bent at 212–220° F. is thermoplastic and less resistant to moisture than untreated wood. Sawdust mixed with 25 percent urea and sufficient water to form a paste, then dried, may be molded under heat and pressure. Wood treated with a solution containing 380 parts urea, 344 parts 37 percent formaldehyde, 231 parts water, 6 parts sodium hydroxide, 39 parts borax and 10 parts glacial acetic acid and boiled can be bent quickly before much thermosetting resin is formed. The product does not soften when heated and is resistant to moisture.

ACRYLIC RESINS. Wm. T. Pearce. Paint Ind. Mag. *56*, 422–4 (1941). The uses of acrylic resins to produce permanent, flexible finishes for textiles and leather and as the plastic interlayer in laminated glass are discussed.

WATER ABSORPTION OF RESIN-IMPREGNATED OREGON PINE. R. S. Hawkins. British Plastics *13*, 406–7 (Mar. 1942). Both water-soluble and alcohol-soluble phenolic resins were used to impregnate wood veneers. Weight and dimensional changes of the cured panels resulting from immersion in water were determined. The water-soluble resins, which presumably are of lower molecular weight, gave the better protection against moisture.

Materials

ETHYLBUTYLCELLULOSE. S. N. Ushakov and N. N. Iznairskaya. Plasticheskie Massy, Sbornik Stateĭ *1939*, 40–50. Ethylbutylcellulose can be prepared by the simultaneous action of butyl chloride and ethyl chloride in a molal ratio of 3 to 7. The etherification requires less time than that required to produce ethylcellulose. The use of larger quantities of butyl chloride results in a decrease in viscosity, softening point and mechanical strength of the product. Films of ethylbutylcellulose have greater resistance to moisture and greater mechanical strength than films of ethylbenzylcellulose. The Arochlors are suitable plasticizers, causing an increase in mechanical strength of the films.

THIOKOL SYNTHETIC RUBBER TYPE RD. J. Crosby. India Rubber World *106*, 133 (May 1942). Thiokol RD differs from other Thiokol products in that it is not a polysulfide reaction product. It is a tough amber solid, specific gravity 1.03, and is compounded, vulcanized and processed in much the same manner as natural rubber. It is reported to be quite resistant to oils and gasoline, and to yield stocks having tensile strengths of over 3000 p.s.i. and elongations of over 400 percent.

THE INTERACTION BETWEEN SOY GLYCININ AND FORMALDEHYDE. E. N. Volkov, P. G. Grigor'ev and O. A. Rezvetsov. J. Applied Chem. (U.S.S.R.) *14*, 416–18 (1941). The globulin-glycinin fibers of the soybean were fixed by treatment with solutions of formaldehyde. After decreasing with gasoline, the ground beans were digested in a 0.2 percent solution of potassium hydroxide. The solution was decanted and the albumin coagulated with hydrochloric acid at the isoelectric point (pH = 4.5–4.6). It was found that the amount of glycinin fixed increases with the concentration of the formaldehyde solution and the duration of the treatment.

VISCOSITIES OF SOLUTIONS OF POLYVINYL CHLORIDE. J. Mead and M. Fuoss. J. Amer. Chem. Soc. *64*, 277–82 (Feb. 1942). The viscosities of a number of polyvinyl chloride samples, fractioned and polydisperse, were studied as a function of concentration, temperature, rate of shear and solvent. The equivalent viscosity is a linear function of concentration. It does not vary much among the solvents nitrobenzene, mesityl oxide, cyclohexane and methyl amyl ketone, and decreases only slightly with increasing temperature. The absolute viscosity of solutions of polyvinyl chloride decreases with increasing pressure; this effect can be eliminated by extrapolation to zero pressure or by an empirical correction formula. An empirical formula is derived which permits determination of the limiting equivalent viscosity for zero concentration from a single viscosity measurement at a finite concentration of polyvinyl chloride. Assuming the validity of the Staudinger equation, the ratio of the limiting equivalent viscosity to molecular weight for vinyl chloride polymers is calculated to be 7×10^{-5}.

Applications

REFRIGERATION INSULATION. B. Quarmby. British Plastics *13*, 376–81 462–66, 545–50 (Mar., Apr., May 1942). The ideal material for refrigeration insulation is described as one which is effective in impeding the passage of heat under service conditions involving high relative humidities. The fundamental aspects of thermal conductivity are discussed and values are tabulated for a wide variety of materials.

CANVAS PILOT SEAT. Aviation Equipment *2*, 12 (May 1942). Cotton duck impregnated with phenolic resin is being molded into seats for pilots on aircraft by the Capac Manufacturing Company. They are replacing aluminum seats with some reduction in weight.

JABLO AIRSCREW BLADES. Aircraft Production *14*, 277 (Apr. 1942). The manufacture of the Jablo resin-bonded wood propeller is described. Birch veneers 0.6 mm. thick are bonded with interleaved phenolic resin film at high pressure. The pressed wooden block is fitted into a metal hub and automatically machined by a motor-driven traversing milling cutter to the proper contour. The wood surfaces are sealed with a coat of enamel, a brass sheath is attached to the leading edge, a phosphor bronze understrip is applied, and further coatings of enamel used to produce smooth surfaces.

METAL PROTECTION BY PLASTIC SHEET AND FILM. E. E. Halls. Plastics *6*, 101–7, 141–7 (Apr., May 1942). Relative moistureproofing values of various membrane materials are tabulated. The effects of various aging conditions on cellulose acetate and rubber hydrochloride films are reported. Dimensional changes are tabulated for transparent plastic sheets when exposed to dry heat at 60° C., immersion in water at 20–25° C., and a cyclic humidity test involving alternate exposure to 70 percent relative humidity at 55–60° C. and 100 percent relative humidity at 20–25° C.

THE USE OF BENZYLCELLULOSE IN THE CABLE INDUSTRY. II. V. O. Sedlis and N. V. Orlova. Plasticheskie Massy, Sbornik Stateĭ *1939*, 69–100. A mixture of 100 parts of benzylcellulose, 36 parts of tricresyl phosphate and kaolin was used as a cable sheathing. The material had a density of 1.20 to 1.25, tensile strength of 0.7–0.8 kg./sq. mm. and elongation of 21–25 percent. The product was difficult to burn, was resistant to water, alkalis, acids, gasoline and oil. The dielectric properties were satisfactory. The softening point was too low. This was increased by using a higher viscosity grade of benzylcellulose, by using less plasticizer, by replacing some of the tricresyl phosphate with linoxyn, alkyd resins or Sovprene, and by changes in the processing technique.


Ewing Galloway

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

BUTADIENE POLYMERS. A. M. Clifford (to Wingfoot Corp.). U. S. 2,279,293, April 14. Interpolymerizing butadiene with allyl (or methallyl) acrylate.

UREA RESINS. S. S. Gutkin (to Falk and Co.). U. S. 2,279,312, April 14. Heating a urea-aldehyde condensate (not resinified) with the ingredients of an alkyd resin.

THERMOPLASTIC TRIM. J. S. Reid (to Standard Products Co.). U. S. 2,279,344–5, April 14. Injection of thermoplastics compounded from particles of various colors, and apparatus for the purpose; and a process for making decorative trim from an organic thermoplastic.

MOLD GATING. J. S. Reid (to Standard Products Co.). U. S. 2,279,380, April 14. An improved gating arrangement for mold cavities used in molding organic plastics by injection.

VINYL POLYMERS. H. Berg (to Chemische Forschungsges. m. b. H.). U. S. 2,279,436, April 14. Producing noncaking globules of vinyl resin by polymerization in aqueous emulsion, first alone and finally in presence of a partially hydrolyzed vinyl polymer.

THIOUREA RESIN. K. Ripper (to American Cyanamid Co). U. S. 2,279,493, April 14. Alkaline condensation of thiourea with formaldehyde at room temperature, followed by thermal hardening.

RESINS IN OIL. F. Seebach (to Bakelite Corp.). U. S. 2,279,499, April 14. Compounding a hardenable phenolic resin with an oxidized drying oil.

MOLDING COMPOSITION. F. J. Grooen and J. H. Lower (to American Cyanamid Co.). U. S. 2,279,512, April 14. Making a thermosetting resin by condensing a phenol with dicyandiamide in presence of ammonia.

SOLUBLE RESIN. Israel Rosenblum. U. S. 2,279,526, April 14. Fusible phenolic resins which are soluble in varnish oils are made by condensing an alkylphenol or a phenol-ketone condensation product with formaldehyde and dipentene.

HOT MELT COATING. W. C. Calvert (to Marbon Corp.). U. S. 2,279,557, April 14. Reacting rubber with a phenol in presence of an acid isomerizing agent, and compounding the product with amylnaphthalene for use in hot melt coatings.

CASEIN MOLDINGS. Fritz Pollak. U. S. 2,279,743, April 14. Compounding casein with anhydrous methylolurea solutions to form a powder which is molded at 70–120 deg. C and hardened at 120 deg. C. or lower.

POLYAMIDES. H. B. Stevenson (to E. I. du Pont de Nemours and Co.). U. S. 2,279,745, April 14. Making fiber-forming polyamides from components, one of which has an alkoxy or aryloxy substituent.

FILM-FORMING POLYAMIDE. R. A. Jacobson (to E. I. du Pont de Nemours and Co.). U. S. 2,279,752, April 14. Polyamides which form solid continuous films are formed from components, one of which contains a ketone group.

ALKYD RESINS. S. C. Smith and R. T. Van Ness (to E. I. du Pont de Nemours and Co.). U. S. 2,279,764, April 14. A distillation process of making alkyd resins by reaction in presence of an organic solvent which flashes off the water of reaction.

COATING WIRE. P. R. Austin (to E. I. du Pont de Nemours and Co.). U. S. 2,279,771, April 14. Passing wire through an aqueous suspension of crystalline polyamide, fusing the film on the wire and quenching the fused film.

POLYAMIDE ENAMEL. E. K. Bolton (to E. I. du Pont de Nemours and Co.). U. S. 2,279,774, April 14. A hard nonchipping enamel finish is obtained from a crystalline linear polyamide by a fusion method.

PLYWOOD CONTAINERS. Geo. C. Hamilton. U. S. 2,279,820, April 14. Joining heads to plywood cylinders by means of a thermosetting cement.

METHACRYLATE INTERPOLYMERS. G. F. D'Alelio (to General Electric Co.). U. S. 2,279,881–2–3–4–5, April 14. Interpolymerizing ethyl methacrylate with di-sec.-butyl, bis-(methoxyethyl), dihexyl, dibenzyl or di-(isobutylcarbinol) itaconate.

PLASTIC SHEETS. D. Domizi (to Carbide and Carbon Chemicals Corp.). U. S. 2,279,901, April 14. Interlayers for safety glass are calendered from a vinyl acetal resin.

ANTIOXIDANTS. M. A. Dietrich (to E. I. du Pont de Nemours and Co.). U. S. 2,279,973, April 14. Use of hydroxamic acids as antioxidants in oils, rubber, superpolyamides, olefin polymers, methyl methacrylate resins and the like.

MOLDING VISCOSE SPONGE. T. F. Banigan and O. E. Snyder (to E. I. du Pont de Nemours and Co.). U. S. 2,280,022, April 14. Extruding viscose sponge composition along a helical path into a mold, while subjecting it to compression between the end of the helix and the mold inlet.

EYEPIECES. B. Anderson (to Celanese Corp. of America). U. S. 2,280,055, April 21. Nonfogging eyepieces for gas masks and goggles are made of cellulose ester, sufficiently hydrolyzed on the inner surface to be moisture-absorbent while retaining its waterproofness on the outer surface.

EYEPIECES. W. H. Moss (to Celanese Corp. of America). U. S. 2,280,097–8, 2,280,482, April 21. Window closures for gas masks and the like are formed in two layers of ester polymer, one being water-resistant and the other hydroscopic; or one surface is composed of a water-insoluble cellulose ester which is soluble in water blended with an organic solvent, or of a vinyl or cellulose ester partially hydrolyzed on the inner surface.

MALEIC ANHYDRIDE RESIN. E. L. Kropa and T. F. Bradley (to American Cyanamid Co.). U. S. 2,280,242, April 21. Condensing maleic anhydride with ethyleneglycol and esterifying the product with methallyl alcohol.

MALEIC ACID RESIN. D. G. Patterson (to American Cyanamid Co.). U. S. 2,280,256, April 21. Condensing maleic acid with ethyleneglycol and allyl alcohol in presence of linseed oil acids and polymerizing the product.

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SULPHUR PLASTIC. P. A. Ray (to Hercules Powder Co.). U. S. 2,280,301, April 21. Plasticizing free sulphur with a terpene polysulphide.

OLEFIN RESINS. F. E. Frey, R. D. Snow and W. A. Schulze (to Phillips Petroleum Co.). U. S. 2,280,818, April 28. Forming high heteropolymers of olefins and sulphur dioxide in presence of an oxidizing agent.

COATED FILM. W. J. Jebens (to E. I. du Pont de Nemours and Co.). U. S. 2,280,829, April 28. Coating regenerated cellulose foils with a polymerized methylolurea ether before applying a moistureproof coating.

OLEORESIN. B. E. Sorenson (to E. I. du Pont de Nemours and Co.). U. S. 2,280,862, April 28. Refluxing a nonconjugated drying oil with a maleate of an unsaturated alcohol to form a resin.

PLASTIC. R. L. Stern (to Hercules Powder Co.). U. S. 2,280,863, April 28. Colloiding cellulose acetate with a plasticizer and adding 0.01 percent or less of an acid to prevent discoloration at molding temperatures.

COMPACTING FILLERS. F. Seebach (to Bakelite Corp.). U. S. 2,280,934, April 28. Compressing loose fibrous filler with 10 percent or less of adhesive and grinding the product for use as a filler in synthetic resin moldings.

TESTING PLASTICS. A. Nadai and H. C. Harrison (to Westinghouse Electric & Mfg. Co.). U. S. 2,280,966, April 28. A compression tester for plastics in which the cross section of the test piece is kept constant by trimming off the bulge.

LAMINATED METAL. A. E. Schuh (to Bell Telephone Laboratories, Inc.). U. S. 2,280,981, April 28. Forming and drying a film of thermoplastic adhesive on metal sheets and heating the assembly under a high pressure.

PENCIL FOR PLASTICS. Mary L. Weiser (to Walt Disney Productions). U. S. 2,280,988, April 28. Pencils for nearly indelible marking on cellulose derivatives or other plastics contain a plasticized wax, a binder, a solvent and a dye.

LAMINATED PRODUCTS. B. J. Dennison (to Pittsburgh Plate Glass Co.). U. S. 2,281,027, April 28. Hot-pressing a laminated assembly of sheets faced with a plastic adhesive and finally covered with a nonporous sheet.

POLARIZERS. E. H. Land (to Polaroid Corp.). U. S. 2,281,100–1, April 28. Softening a transparent plastic sheet superficially and pressing fine crystals of a polarizing substance into the surface in oriented arrangement; and superimposing sheets of transparent plastic having polarizing areas arranged to form stereoscopic images.

RUBBER HYDROCHLORIDE. H. F. Irving and F. E. Williams (to Marbon Corp.). U. S. 2,281,355, April 28. Reacting rubber with liquid hydrogen chloride and releasing excess hydrogen chloride from it by contact with hot saturated aqueous hydrochloric acid.

RUBBER HYDROHALIDES. W. J. Burke and F. T. Peters (to E. I. du Pont de Nemours and Co.). U. S. 2,281,410, April 28. Stabilizing rubber hydrohalides by adding 1–10 percent of a symmetrical bis(dialkylaminomethyl)urea having short or long chain alkyl groups.

POLYESTER AMIDES. D. D. Coffman (to E. I. du Pont de Nemours and Co.). U. S. 2,281,415, April 28. Fiber-forming linear polymers are formed by reacting a dicarboxylic acid both with a diamine and a glycol so that ester and amide groups are present in the polymer.

RUBBER HYDROCHLORIDE. A. Hershberger (to E. I. du Pont de Nemours and Co.). U. S. 2,281,436–7, April 28. Stabilizing rubber hydrochloride with 12 percent or less of a polyethylene polyamine salt of lauric acid or a higher acid; or with 5 percent of benzyltrimethylammonium stearate.

LAMINATED FOILS. D. E. Edgar (to E. I. du Pont de Nemours and Co.). U. S. 2,281,483, April 28. A thermoplastic adhesive for bonding foils together contains a cellulose derivative and a synthetic resin which is compatible therewith.

WRAPPING FROZEN FOODS. F. H. Reichel and R. T. K. Cornwell (to Sylvania Industrial Corp.). U. S. 2,281,513, April 28. Nonadhering foil which protects frozen foods from desiccation and freezer burn comprises an organic colloid plasticized with water, glycerol and diethyleneglycol.

UREA RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,281,559, May 5. Making thermosetting resins by condensing urea and a haloacylated urea with an aldehyde.

FILM. E. K. Ellingboe and P. L. Salzberg (to E. I. du Pont de Nemours and Co.). U. S. 2,281,567, May 5. A self-sustaining film of rubber hydrochloride compounded with 10 percent of a phenol-formaldehyde-methylamine resin.

POLYAMIDES. W. E. Hanford (to E. I. du Pont de Nemours and Co.). U. S. 2,281,576, May 5. Reacting a dicarboxylic acid first with a short chain diamine and then with a longer chain diamine to form a linear polyamide.

SOY CASEIN PLASTIC. P. L. Julian and E. B. Oberg (to Glidden Co.). U. S. 2,281,584, May 5. A molding powder made from soy casein and a phenol-aldehyde or urea-aldehyde resin.

POLYMERIZATION. H. Wollthan and W. Becker (to Jasco, Inc.). U. S. 2,281,613, May 5. Emulsion polymerization of butadiene, alone or with another polymerizable compound, in presence of hexyl mercaptan or its higher homologs.

PLASTIC FILM. Chas. Strauss (to Arvey Corp.). U. S. 2,281,635, May 5. Translucent or transparent sheets are formed by interposing a wide mesh of nonfibrous plastic strands between two layers of plastic.

PHOTOGRAPHIC EMULSIONS. W. G. Lowe (to Eastman Kodak Co.). U. S. 2,281,703, May 5. Adding a vinyl acetal resin to an aqueous silver halide emulsion.

PHOTOPOLYMERIZATION. J. Heerema and J. S. Owens (to Dow Chemical Co.). U. S. 2,281,768, May 5. Vapor polymerization of vinyl chloride with ultraviolet light.

FROSTING LUCITE. David O. Ford (one-half to O. E. Crocker). U. S. 2,281,837, May 5. Etching a freshly cleaned Lucite surface, while still warm from flashing off the solvent, by air-blasting till the surface is whitened.

SUPERPOLYAMIDES. H. Ufer and A. Weickmann (to E. I. du Pont de Nemours and Co.). U. S. 2,281,961, May 5. Forming superpolyamides in presence of not more than 3 percent of a free or partially etherified or esterified polyhydric alcohol.

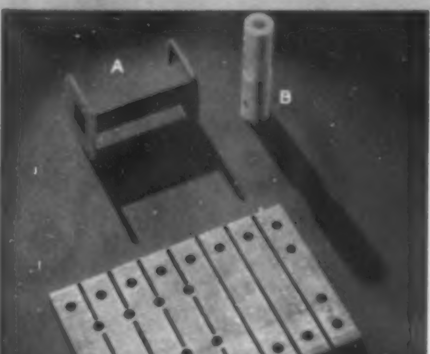
POLYSTYRENE. T. R. Scott and M. C. Field (to International Standard Electric Corp.). U. S. 2,282,002, May 5. Dissolving an olefin polymer in monomeric styrene and polymerizing the styrene.

PLASTICIZER. G. Alexander (to General Electric Co.). U. S. 2,282,017, May 5. Modifying a cresol-formaldehyde resin with tung or oiticica oil for use as a plasticizer.

ACETAL RESINS. B. C. Bren, J. H. Hopkins and G. H. Wilder (to E. I. du Pont de Nemours and Co.). U. S. 2,282,026, May 5. Steeping a vinyl acetal resin powder in an alkaline aqueous medium and reacting it with urea, methacrylylurea or di-*o*-tolylguanidine in alkaline medium.

Photo by U. S. Army Signal Corps

How a Shot in the Dark Finds Its Mark



A—Square tube coil form sanded to size; flanges milled, sawed and broached.

B—Insulating tube, sawed, drilled, reamed, and milled.

C—Sawed, milled and drilled terminal panel.

THE destruction of enemy planes at night is dependent upon electrical teamwork. Efficient work of battery units and the reliability of the communications between them require a dependable insulation.

Synthane's combination of physical and electrical properties makes it as useful in war as in peacetime production. Among them are excellent electrical insulating characteristics, light weight, structural strength, ease of machining and resistance to corrosion from solvents, water, many acids and salts.

As an aid to essential industries, some of which are using Synthane for the first time, and as a help to peacetime planners, the information on the back of this advertisement may prove helpful. We'll be glad to supply additional information if you'll write us.

Plan your future with plastics.

SYNTHANE CORPORATION, OAKS, PENNA.

SYNTHANE TECHNICAL PLASTICS

SHEETS · RODS · TUBES · FABRICATED PARTS — SYNTHANE — SILENT STABILIZED GEAR MATERIAL

Bakelite—laminated

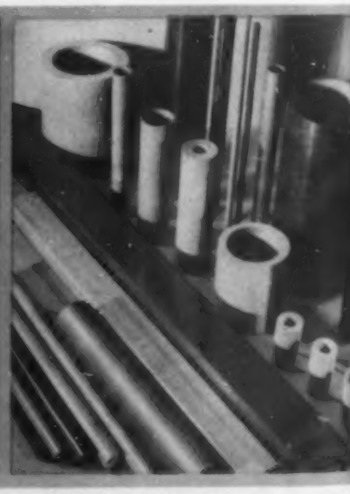
STANDARDS OF QUALITY FOR

SYNTHANE BAKELITE-LAMINATED SHEETS

BLACK figures are actual test values, BROWN figures are RELATIVE values for use in comparing grades—100 indicates the most favorable relative value.

GRADE	(1) Tensile Strength	(1) Transverse Strength	(1) Compressive Strength	(2) Dielectric Strength: Short-Time Test	(2) Dielectric Strength: Step-by-Step Test	(3) Power Factor	(3) Dielectric Constant	(3) Dielectric Loss Factor	(4) % Water Absorption	Impact Strength	Recommended Temperatures for Punching * †
	Pounds per Square Inch			Volts per Mil. (.001")		At 1,000,000 Cycles					
X	12,500 100	21,000 100	35,000 90	700 100	500 100	.050 55	5.5 80	.27 45	4.0 20	40	Cold to $\frac{1}{32}$" Hot to $\frac{3}{32}$"
XX	8,000 65	16,000 75	34,000 90	700 100	500 100	.040 70	5.0 90	.20 60	1.3 70	30	Cold to $\frac{1}{32}$" Hot to $\frac{3}{32}$"
XXX	7,000 55	15,000 70	32,000 85	650 95	450 90	.032 85	4.8 95	.15 80	1.0 90	20	Hot to $\frac{1}{16}$" (Simple shapes, compound dies only)
XP	8,000 65	15,000 70	22,000 60	700 100	500 100	.045 60	5.0 90	.22 55	3.0 30	40	Cold to $\frac{1}{16}$" Warm to $\frac{1}{8}$"
XXP	8,000 65	16,000 75	25,000 65	700 100	500 100	.040 70	5.0 90	.20 60	1.3 70	30	Cold to $\frac{1}{32}$" Warm to $\frac{1}{8}$"
XXXP	7,000 55	15,000 70	25,000 65	650 95	450 90	.027 100	4.5 100	.12 100	1.0 90	20	Warm to $\frac{1}{32}$" Hot to $\frac{3}{32}$"
C	9,500 75	20,000 95	38,000 100	200 30	120 25	.10 25	7.0 65	.70 15	1.7 55	100	Cold to $\frac{1}{16}$" Hot to $\frac{3}{16}$"
CE	8,000 65	17,000 80	36,000 95	500 70	300 60	.055 50	5.5 80	.30 40	1.2 75	80	Cold to $\frac{1}{32}$" Hot to $\frac{3}{32}$"
L	9,000 70	20,000 95	35,000 90	200 30	120 25	.10 25	7.0 65	.70 15	1.4 65	70	Cold to $\frac{1}{16}$" Hot to $\frac{3}{16}$"
LE	8,500 65	19,000 90	37,000 95	500 70	300 60	.045 60	5.0 90	.22 55	.90 100	60	Cold to $\frac{1}{32}$" Hot to $\frac{3}{32}$"

ALL VALUES ABOVE REPRESENT MINIMUM AVERAGES FOR STANDARD GRADES.



METHODS FOR TESTING SYNTHANE

1. Tests were made at room temperature, approximately 25 deg. C., following the American Society for Testing Materials Method D-229-39. All thicknesses up to 1 inch, inclusive.

2. Tests were made under oil on $\frac{1}{16}$" thickness, according to American Society for Testing Materials Method D-149-40-T.

3. Tests were made at a frequency of 1,000,000 $\left(\frac{-6}{10}\right)$ cycles, according to American Society for Testing Materials Method D-150-41-T. All thicknesses up to 1 inch, inclusive.

4. Tests were made on pieces 3" x 1" x $\frac{1}{16}$" thick, according to the American Society for Testing Materials Method D-229-39 after immersion in water for 24 hours at approximately 25 deg. C. plus or minus 2 deg. C. (For grades C, CE, L, LE, $\frac{1}{8}$" thickness was used.)

SYNTHANE

Bakelite — laminated

SYNTHANE CORPORATION

OAKS, PENNA.

REPRESENTATIVES IN ALL PRINCIPAL CITIES

MACHINEABILITY OF SYNTHANE SHEETS

*Temperature Standards for Punching.

Cold is room temperature, not under 60° F.

Warm is 120° F. to 150° F.

Hot is 175° F. to 250° F.

†All grades of Synthane may be easily sawed, drilled, turned, milled, etc. See Synthane folder on machining.

GRANULAR RESIN. J. Dahle (to Monsanto Chemical Co.). U. S. 2,282,037, May 5. Forming a granular precipitate of vinyl acetal resin by gelling a colloidal solution of the resin while stirring so that porous granules are formed.

STABILIZING ACETAL RESINS. J. H. Hopkins and G. H. Wilder (to E. I. du Pont de Nemours and Co.). U. S. 2,282,-057, May 5. Refining and stabilizing crude vinyl acetal resins by steeping in an alkaline aqueous medium containing a solvent for the resin.

CHLOROACRYLATES. M. A. Pollack (to Pittsburgh Plate Glass Co.). U. S. 2,282,088, May 5. Polymerizing a chloroacrylate of an unsaturated alcohol.

MOLDING DIE. A. F. Bandur (to Western Electric Co., Inc.). U. S. 2,282,155, May 5. A molding die having a die base with a tapered circular recess in which shaped die sections are situated.

BAG. J. E. Snyder (to Wingfoot Corp.). U. S. 2,292,258, May 5. A double wall bag has both walls made of rubber hydrochloride, but only the outer wall is plasticized to increase its strength.

POLYSULPHIDE PLASTICS. J. C. Patrick (to Thiokol Corp.). U. S. 2,282,287, May 5. Forming a polymer from a polysulphide and bis(chloroethoxy)diethyl ether, then treating the product with a desulphurizing agent.

SLIDE FASTENERS. G. Dahlin (to Lightning Fastener Co., Ltd.). U. S. 2,282,308, May 12. An improved machine for injection molding of interlocking slide fastener parts directly on a tape.

SAFETY GLASS. P. Finnegan (to American Window Glass Co.). U. S. 2,282,399, May 12. Applying the interlayer to glass plates for safety glass by flowing a film of solution of the interlayer onto the moving glass plate.

HOLLOW ARTICLES. W. H. Kopitke (to Plax Corp.). U. S. 2,282,423, May 12. Shaping hollow articles by drawing a softened sheet of thermoplastic between inner and outer dies while surrounding the inner die with an air cushion to prevent excessive cooling of the plastic.

PRINTING PLATE. H. Beck and W Kuehne (to E. I. du Pont de Nemours and Co.). U. S. 2,282,448, May 12. Forming printing plates from a superpolyamide.

POLYMER RESINS. Friedrich Christmann, Heinz Lemme and Hans Bueren (to Wm. E. Currie). U. S. 2,282,456, May 12. Condensing gaseous or liquid unsaturates with an aromatic polymer or condensation resin in presence of a fluoride catalyst such as boron trifluoride.

LIGNIN RESINS. C. A. Hochwalt and M. Plunguian (to Mead Corp.). U. S. 2,282,518, May 12. Thermosetting resins for waterproof moldings are made by effecting a phenol-aldehyde condensation in presence of lignin solids recovered from black liquor.

ALKYD RESIN. H. S. Rothrock (to E. I. du Pont de Nemours and Co.). U. S. 2,282,827, May 12. Treating alkyd resins with a polycyanate or polythiocyanate.

RESISTANCE TAPE. L. W. Spooner (to General Electric Co.). U. S. 2,282,832, May 12. Suspending carbon black in unplasticized cellulose acetate to form a semiconducting tape.

ACRYLATE RESIN GEL. W. I. Patnode (to General Electric Co.). U. S. 2,282,882, May 12. A stable infusible gel containing less than 20 vol.-percent of an acrylate or methacrylate of an unsaturated alcohol in a liquid nonpolymerizable chlorinated aromatic hydrocarbon.

RESIN VARNISH. I. C. Clare (to Hercules Powder Co.). U. S. 2,283,353, May 19. Adding a liquid rosin derivative and an oil-soluble phenol-aldehyde resin to a drying oil.

HEMICELLULOSE RESIN. Max Phillips (to the People of the U. S. A.). U. S. 2,283,458, May 19. Making a resin by acid condensation of a hemicellulose with a phenol.

POLYSTYRENE. W. R. Collings, D. L. Gibb and G. P. Schmelter (to Dow Chemical Co.). U. S. 2,283,539, May 19. Heating styrene or its analogs to form a solution of polymer in the monomer, evaporating the solution in thin layers, stripping the porous layer of cooled polymer from its base and pulverizing the resin.

POLYMER DERIVATIVES. A. H. Gleason (to Jasco, Inc.). U. S. 2,283,627, May 19. Making macromolecular halogenated sulfurized derivatives of linear plastic hydrocarbon polymers by polymerizing an iso-olefin and reacting the polymer with sulfur chloride.

MOLDING COLLOIDS. P. L. Mergier and P. E. Leroy. U. S. 2,283,688, May 19. Hardening a viscous colloidal solution by adding a granular solid colloid to absorb solvent, the final hardening and setting being effected in a mold.

MULTIPLY FABRIC. F. R. Redman (to Cluett, Peabody and Co.). U. S. 2,283,698, May 19. Bonding fabric plies together with a layer of launderable methacrylate resin.

ADHESIVE. H. Klemm (to Davis and Co., Inc.). U. S. 2,283,740, May 19. Compounding a cold-setting urea-formaldehyde resin with a C-stage synthetic resin to make a spreadable glue.

HOLLOW ARTICLES. E. T. Ferngren (to Plax Corp.). U. S. 2,283,751, May 19. Extruding an organic plastic through an annular orifice, closing the end of the extruded tube and severing the tube at the edge of the zone to which pressure was applied.

JACKET CROWN. M. B. Brenner. U. S. 2,283,786, May 19. A jacket crown for a tooth is moldable from a commercial plastic and is fitted to the prepared portion of an original tooth.

LIGNOCELLULOSE MOLDINGS. A. W. Schorger and J. H. Ferguson (to Burgess Cellulose Co.). U. S. 2,283,820–1, May 19. Thermoplastic lignocellulose which yields hard waterproof moldings is made from comminuted wood by high-temperature cooking.

OLEFIN RESIN. M. M. Barnett (to Freeport Sulphur Co.). U. S. 2,283,900, May 26. Using ascaridole and a halogen acid to catalyze the resin-forming condensation of olefins with sulfur dioxide.

PHONOGRAPH RECORD. J. H. Hunter (to Radio Corp. of America). U. S. 2,284,091, May 26. Compounding shellac with zein by incorporating the zein first in oxidized abietic acid.

VINYL RESIN FOILS. F. M. Meigs (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,284,100, May 26. Making moistureproof transparent foils from polyvinyl alcohol with 3–4.5 percent wax, 4.5–12 percent of a long chain monoalkyldicarboxylate and 10–25 percent of modified or hydrogenated rosin.

CYANOBUTADIENE POLYMERS. B. J. Habgood, E. Isaacs and L. B. Morgan (to Imperial Chemical Industries, Ltd.). U. S. 2,284,280–1, May 26. Emulsion polymerization of chloroprene, butadiene, isoprene or dimethylbutadiene with a smaller amount of cyanobutadiene to make a rubber-like product.

MENAPHTHYLCELLULOSE. W. Hentrich and R. Köhler (to Procter and Gamble Co.). U. S. 2,284,282, May 26. Tetrahydromenaphthylcellulose as a new product.

Technical briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments

Engineering

A NEW PLASTIC MATERIAL FOR BEARING LINERS AND ITS APPLICATION ON AXLE BEARINGS. H. Makelt. Braunkohle *39*, 351–4 (1940). Results of laboratory and service tests made on axle bearing liners of mine cars are given. The liners were made of a plastic composition containing asbestos and other fillers. The compressive strength, bearing temperature and length of service show that the plastic mixture tested makes a suitable bearing liner even under high loads.

PRODUCTION OF COUMARONE RESIN WITH A SOFTENING TEMPERATURE OF 100–150° C. M. A. Stepanenko and A. E. Minskaya. Coke and Chemistry (U.S.S.R.) *1940*, No. 2, 33–6. Experimental and industrial production of coumarone resins is described. The process used involved the polymerization of the xylene fraction and the xylene-heavy fraction with anhydrous aluminum chloride. In the first case the softening temperature of the resin obtained was 100–130° C. and in the second as high as 150° C. A better resin was obtained with aluminum chloride than with sulfuric acid. The raw material fraction should contain not greater than 30 percent polymerizable material and must be preheated to 45° C. before the aluminum chloride is added. The product was filtered, washed with water and sodium hydroxide solution until neutral, and the liquid materials distilled off to obtain the solid resin.

MODIFICATION OF SHELLAC AND SHELLAC COMPONENTS WITH MELAMINE AND FORMALDEHYDE. Y. Sankaranarayanan and H. K. Sen. Indian Lac Research Inst., Research Note No. 22, 3 pp. (1940). Dewaxed shellac was condensed with melamine and formaldehyde in ethyl alcohol solution to produce thermosetting resin which can be injection molded.

SHELLAC-COAL TAR MOLDING POWDERS. M. Venugopalan and H. K. Sen. Indian Lac Research Inst., Research Note No. 23, 2 pp. (1940). Molding powders are produced by treating lac with formaldehyde and dry tar, refluxing with urea in ethyl alcohol, mixing with woodflour and calcium stearate, drying and crushing.

Chemistry

LOSS OF PLASTICIZERS FROM POLYVINYL CHLORIDE PLASTICS IN VACUUM. H. A. Liebhafsky, A. L. Marshall and Frank H. Verhoek. Ind. Eng. Chem. *34*, 704–8 (June 1942). A study of the losses of three plasticizers (tricresyl phosphate, dibutyl phthalate, dibenzyl sebacate) from polyvinyl chloride plastics into vacuum between 110° and 155° C. has shown that (a) all three plasticizers are lost at about the same rate, indicating that physical (e.g., van der Waals), rather than chemical (i.e., valence) forces, are involved in plasticization by these substances; (b) with tricresyl phosphate, and presumably also with the others, the diffusion constant decreases rapidly with the concentration of plasticizer, so that a plastic under experimental conditions tends to seal itself against further loss as plasticizer disappears; (c) the volume shrinkage of the plastic is approximately isotropic and equal to the liquid volume of plasticizer lost. The following simple picture fits these observations: van der Waals forces between plasticizer and polyvinyl chloride molecules make plastic the polyvinyl chloride by separating from one another the chain molecules of which the latter is composed. As plasticizer is removed, the van der Waals forces among the chains bring them closer together, thus making it more difficult for the remaining plasticizer molecules to get out, and conserving the volume additivity apparently characteristic of these plastics. The diffusion processes are so complex that no exact treatment of the results was possible.

PROTEIN-ALDEHYDE PLASTICS. D. C. Carpenter and F. E. Lovelace. Ind. Eng. Chem. *34*, 759–63 (June 1942). The combining ratios between formaldehyde and acid and rennet casein are established over a concentration range up to 6.63 percent formaldehyde. Acid and rennet casein are different from each other in the binding of formaldehyde. The general law applicable to both acid and rennet casein, relating bound formaldehyde to total formaldehyde employed, is shown to be the adsorption law, $X = KC^n$, in the concentration range investigated. The results indicate that some 30 percent more aldehyde is bound than can be accounted for on the basis of combining with alpha-amino, side-chain amino and amide groups. It is suggested that aldehyde combination with the hydroxy acids of the protein may take place, and that acetal-like compounds will result which will form —O—CH_2—O— or —O—CH_2—O—CH_2—O bridges and thus unite the side chains of protein molecules. Trioxymethylene rings, formed from formaldehyde and enolized ketone groups of the protein, may join protein plastic molecules together, further utilizing aldehyde.

EFFECT OF SOLVENTS UPON SOLID ORGANIC PLASTICS. John Delmonte. Ind. Eng. Chem. *34*, 764–70 (June 1942). Solvents are classified according to the degree with which they reduce the shear strength of plastics. Complete loss of strength accompanied by formation of a smooth solution identifies a true solvent. Nonsolvents are classified into three groups: (1) those which weaken and swell the plastic, (2) those which only weaken it and (3) those which have no effect. Solvents which exhibit the greatest initial rate of penetration are also the first to dissolve the plastic completely. Quantitative data are given for the effect of fourteen representative solvents upon cellulose nitrate, acetate and acetate butyrate, polyvinyl chloride-acetate, polystyrene, polymethyl methacrylate and laminated phenolic plastics. An equation is derived for the solvent power of an organic solvent upon a plastic, $S = \frac{K}{R}e^{-(t/xR)}$ where K is an arbitrary value which is constant for a given solvent upon all types of plastic, R is a resistance coefficient, t is the time and x the thickness. The effects of conditioning, temperature and material thicknesses are expressed in separate curves. The usefulness of the punch and die as a rapid analytical tool for evaluating the effect of solvents on plastics is emphasized.

Testing

USE OF THE TYNDALL EFFECT FOR DETERMINATION OF STRAINS IN TRANSPARENT SOLIDS. H. J. Menges. Z. Techn. Phys. *21*, 384–86 (1940). The polarization of light passing through a transparent solid corresponds to the state of strain in the interior. Such states of strain were determined by the Tyndall effect. The optical system used to study this effect consisted of a mercury lamp, filter and lens which provided a beam of monochromatic light, some of which was passed through a diaphragm, nicol prism and a transparent test solid. It was possible to rotate the diaphragm, prism and test solid about a common axis and to set them at a determined angle. A tube with a lens and photoelectric cell was mounted so that light scattered at right angles from any small portion of the polarized beam could be focused on the cell for measurement. Preliminary results agree satisfactorily with theoretical calculations.

Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

The Progress of Science—A Review of 1941

Edited by H. Horton Sheldon and S. Edward Farquhar

The Grolier Society, 2 West 45th St., New York 1942

Price $7.50 404 pages

For the second year, the editors of this excellent review have collaborated with over 100 specialists in their respective fields to produce a volume that is at the same time highly factual and eminently readable. As the foreword explains, much of the scientific work of the year 1941 was in connection with the war effort and, in the national interest, could not be included in the volume. Advances in pure and applied science not of a confidential nature, however, each with a brief bibliography appended, are reviewed in alphabetical order by competent authorities. Numerous biographies of men and women of science are based on material supplied by their subjects, who have checked the completed sketches to insure accuracy. A topical analysis provides cross references, breaks down the more comprehensive articles and serves as an index, and the volume is illustrated.

The general article on plastics this year was contributed by Dr. Gordon M. Kline, Chief of the Organic Plastics Section, National Bureau of Standards, and MODERN PLASTICS' technical editor. Dr. Kline reviews recent developments in the use of lignin, soybeans, bagasse and coffee beans in the plastics field; discusses significant applications of plastics during 1941, particularly in aeronautics and motor transportation; describes the rapid advances made in extrusion molding; and explains the function of synthetic resins as water softeners and purifiers. D.M.

Technical Report Writing

by Fred H. Rhodes

Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, 1941

Price $1.50 125 pages

"Literary writing may be like an etching in which the skillfully drawn lines suggest the mass and sweep of a great bridge; a technical report must be like the plans of the bridge in which is set forth every essential detail of the structure. The preparation of a good technical report is an art, but it is an art in which clarity and precision of expression are fundamental." The author has followed most of his own rules in contributing this splendid guide to effective report writing. However, he has failed to observe his recommendation that the title should adequately indicate the subject matter. "Reporting and Analyzing Technical Data" would better serve to indicate the scope of this book.

As a first step in the process of transmission of information from the investigator to the reader, the proper recording of notes and data in the laboratory notebook is discussed. The simpler methods of analyzing, correlating and depicting the experimental data are reviewed. The organization of the written report is considered in detail with particular emphasis on those features of form and style which experience has shown are generally useful in making the report clearer and more readily usable. Finally, a chapter is devoted to the problem of selecting and arranging material for the oral presentation of a technical report. The valuable and practicable suggestions given in this book should be helpful to investigators in science and engineering fields. G. M. K.

★ ETHYL RUBBER, A BOOKLET JUST PUBLISHED BY the Hercules Powder Co., Wilmington, Del., discusses preliminary test data on ethyl cellulose in soft plasticized compositions using from 40 to 60 percent of various oils and chemical plasticizers. The tests described may figure as a factor in rubber substitution work. Tests described in the booklet include the water absorption; dimensional stability in water; room temperature; dimensional stability in boiling water; Elmendorf tear test; abrasion resistance; Pfund hardness; penetration melting point test; Shore hardness; tensile strength and elongation; permanent set; flexibility; burning rate; and effect of various oils, etc., on the samples tested. A large chart lists the results of each test on the 37 compositions. (A complete article on the subject will appear in MODERN PLASTICS shortly.)

★ A NEW BULLETIN, NO. 105, HAS JUST BEEN ISSUED by the Despatch Oven Co., Phila., Penna., which describes and illustrates their new line of Victory ovens. The bulletin includes a schematic diagram showing the air travel in the new equipment, and discusses other important aspects.

★ A NEW FOLDER ENTITLED *ABRASIVE SEGMENTS* recently issued by Paper and Industrial Appliances, Inc., New York City, is devoted to a discussion of Attritor Abrasives. The folder includes a description of the grinding medium, its applications (particularly in the paper and pulp industries), construction, etc. Attritor abrasive segments are described as suitable for any equipment used for refining and grinding.

★ *YOUR CAREER IN PLASTICS*, BY E. F. LOUGEE, onetime editor of MODERN PLASTICS magazine and now chairman of the advisory board of Plastics Institute, Los Angeles, outlines the opportunities existing in the rapidly expanding plastics industry and indicates the educational background necessary for entering its various branches.

★ A BOOKLET CALLED *PLANT EFFICIENCY* HAS just been published by the Division of Information, War Production Board, and is now available for distribution upon request. Copies may be secured from the regional and local offices of the War Production Board, from the Washington office or local offices of the Division of Information, Office for Emergency Management. The booklet is lucidly written and intended primarily for the smaller war plants or for plants just getting into war production work. Chapters in the book deal with good lighting; cutting down accidents; adapting old machines to new jobs; maintenance and repair; longer life for cutting tools; etc.

★ THE PENNSYLVANIA FLEXIBLE METALLIC TUBing Co., Philadelphia, Penna., has recently issued a comprehensive bulletin on the multiple uses of all-metal flexible hose and tubing on engines of the diesel type. The 8-page bulletin, No. 71, contains photographs and full descriptive matter covering the specifications and qualities of various types of tubing available.

★ A NEW 12-PAGE MANUAL, NO. 2, HAS JUST BEEN issued by the Palnut Co., Inc., Irvington, N. J., devoted to their self-locking Palnuts, with illustrations and text describing their applications, design, locking principle and advantages. The manual is intended for design engineers working on assemblies where light weight is a factor.

★ GENERAL DYESTUFF CORP., 435 HUDSON ST., N. Y. C., has released a new circular called Azosol Fast Orange 3RA, which calls attention to the new addition to their line of colors. The new dye is described as being suitable for the coloring of spirit varnishes, of nitro lacquers, and for the manufacture of aniline inks. It is also reported to be suited for the coloring of plastics like cellulose nitrate, ethyl cellulose, cellulose acetate and phenolic resins.

★ PEABODY ENGINEERING CORP., 580 FIFTH AVE., New York City, has issued a 4-page folder describing the firm's oil, gas and combined gas and oil burners, and discussing the system of conversion from one type to another.

An advance release on the plastics molding machinery order, discussed on page 98 of this issue, was received when MODERN PLASTICS was already on the presses. The following is a digest of the order—General Limitation Order L-159—complete copies of which may be obtained by application to the WPB.

GENERAL LIMITATION ORDER L-159. PLASTICS MOLDING MACHINERY. ISSUED JULY 4, 1942.

The fulfillment of requirements of the war program of the United States has created a shortage in the supply of certain critical materials used in the manufacture of plastics molding machinery for the war program, for private account and for export; and the following order is deemed necessary and appropriate in the public interest and to promote the war program.

SECTION 3002. GENERAL LIMITATION ORDER NO. L-159.

(a) **Definitions.** For the purposes of this order.

(1) "Person" means an individual, partnership, association, business trust, corporation, governmental corporation or agency, or any organized group of persons, whether incorporated or not.

(2) "Plastics Molding Machinery" means new machinery, of the kinds listed in List A, designed for use in the molding of plastic materials. For the purposes of this sub-paragraph (a) (2) new machinery is machinery which has not been delivered to any person acquiring it for use.

(3) "Manufacturer" means any person producing plastics molding machinery whether for his own use or for sale.

(4) "Dealer" means any person regularly engaged in the business of buying or otherwise acquiring plastics molding machinery for resale.

(5) "Order" means any commitment or other arrangement for the delivery of plastics molding machinery, whether by purchase, lease, rental, or otherwise.

(6) "Approved Order" means:

(i) Any order for plastics molding machinery, when accompanied by a PD-3a certificate, to be delivered to and for the use of the Army or Navy, the Maritime Commission, the War Shipping Administration, the Panama Canal, the Coast and Geodetic Survey, the Coast Guard, the Civil Aeronautics Authority, the National Advisory Committee for Aeronautics, the Office of Scientific Research and Development. The provisions of this sub-paragraph (a) (6) (i) shall not apply to orders for any privately operated plant or shipyard or other enterprise whether or not financed or controlled by any of the agencies or organizations mentioned in this sub-paragraph (i), or operated under their control or direction on a cost-plus-fixed-fee basis.

(ii) Any order for plastics molding machinery, when accompanied by a PD-3a certificate to be delivered to, or for the account of, the government of any of the following countries: Belgium, China, Czechoslovakia, Free France, Greece, Iceland, Netherlands, Norway, Poland, Russia, Turkey, United Kingdom including its Dominions, Crown Colonies, and Protectorates, and Yugoslavia.

(iii) Any order for plastics molding machinery placed by any agency of the United States Government to be delivered to, or for the account of, the government of any country listed above or any other country, including those in the Western Hemisphere, pursuant to the act of March 11, 1941, entitled "An Act to Promote the Defense of the United States" (Lend-Lease Act).

(iv) Any order for plastics molding machinery bearing a preference rating of A-9 or higher assigned by a preference rating certificate PD-3 or PD-3a countersigned prior to the effective date of this order, by a preference rating order in the P-19 series issued prior to the effective date of this order, or by a preference rating certificate PD-1 or PD-1a, or preference rating order P-19h, PD-200, or 200a issued at any time, after the issuance of this order preference rating certificate PD-3a shall be used only to assign preference ratings to approved orders of the kinds described in sub-paragraphs (i) and (ii) hereof. Any preference rating certificate or order of any of the kinds enumerated above may be used to secure plastics molding machinery only by the person to whom it was originally issued and only when such machinery is expressly specified on the certificate or order/or its form PD-200 or 200a. Any person placing an approved order for plastics molding machinery bearing a rating assigned by any such certificate or order who does not deliver such certificate or order but retains the same, as permitted by Priorities Regulation No. 3, as amended from time to time, or by the terms of the preference rating order shall, in addition to furnishing the endorsement required by such Priorities Regulation No. 3, as amended from time to time, or such preference rating order, certify to the person from whom the machinery is to be acquired that the certificate or order was originally issued to him and that the plastics molding machinery ordered was expressly specified on the certificate or order, or its form PD-200 or 200a.

(v) Any order which the Director of Industry Operations authorizes for production or delivery pursuant to paragraph (b) (2) hereof. Provided, however, that any order for plastics molding machinery on the books of any manufacturer or dealer on the date of issuance of this order, which is an approved order solely by reason of the provisions of sub-paragraph (a) (6) (iv) or (v) above, shall cease to be an approved order if not delivered prior to the expiration of thirty days following the date of issuance of this order.

(b) **Restrictions on Acceptance of Orders for Production, Delivery and Acquisition of Plastics Molding Machinery.**

(1) General Prohibitions. No person shall accept any order for plastics molding machinery, or delivery or produce any plastics molding machinery in fulfillment of any order, whether accepted or not, unless such order is an approved order. No person shall accept delivery of any plastics molding machinery except pursuant to an approved order.

(2) Procedure for Authorization of Orders on Books. Manufacturers or dealers may apply for authorization to deliver orders which are not approved orders, on their books on the date of issuance of this order as it affects classes of plastics molding machinery from time to time, by filing with the War Production Board, Form PD-554 furnishing the information specified therein. The Director of Industry Operations may thereupon, if he shall deem it necessary or appropriate, authorize the delivery of any such orders, or the assignment of preference ratings thereto.

(c) **Repair and Maintenance Parts.** Notwithstanding the prohibition of paragraph (b) repair and maintenance parts for plastics molding machinery may be produced, delivered or acquired in accordance with the following limitations:

(1) No person shall accept delivery of repair and maintenance parts except as follows:

(i) To repair an actual breakdown where the required repair and maintenance parts are not otherwise available, or

(ii) To acquire repair and maintenance parts of any kind, providing such acquisition will not increase the inventory of the purchaser to an amount in excess of the average inventory of such kind of repair on hand during the last three months of the calendar year 1941.

(2) Manufacturers may produce repair or maintenance parts in minimum quantities sufficient to make the deliveries provided for in subparagraph (i) of this paragraph (c).

(d) **Existing Contracts.** Fulfillment of contracts or orders in violation of this order is prohibited regardless of whether such contracts or orders are entered into before or after the date of issuance of this order. No person shall be held liable for damages or penalties for any default under any contract or order which shall result directly or indirectly from compliance with the terms of this order.

(e) **Applicability of Priorities Regulation No. 1.** This order and all transactions affected thereby are subject to the provisions of Priorities Regulation No. 1, Part 944, as amended from time to time except to the extent that any provision hereof may be inconsistent therewith, in which case the provisions of this order shall govern.

(f) **Appeals.** Any person affected by this order who considers that compliance therewith would work an exceptional and unreasonable hardship upon him may appeal to the War Production Board setting forth the pertinent facts and the reason he considers he is entitled to relief. The Director of Industry Operations may thereupon take such action as he deems appropriate.

(g) **Communications to War Production Board.** All reports required to be filed hereunder, and all communications concerning this order shall, unless otherwise directed, be addressed to — "War Production Board, Special Industrial Machinery Branch, Washington, D. C. REF—L-159".

(h) **Violations.** Any person who wilfully violates any provision of this order, or who wilfully furnishes false information to the Director of Industry Operations in connection with this order is guilty of a crime and upon conviction may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using material under priority control and may be deprived of priorities assistance by the Director of Industry Operations.

(i) **Records and Reports.**

(1) All manufacturers and dealers affected by this order shall keep and preserve for not less than two years accurate and complete records concerning production, deliveries, and orders for plastics molding machinery.

(2) All persons affected by this order shall execute and file with the Division of Industry Operations, War Production Board, such reports and questionnaires as said division shall from time to time request.

Covered by the order L-159 are: Plastic injection molding presses, plastic compression molding presses (hydraulic, automatic, mechanical), plastic extrusion molding presses, plastic preforming presses, plastic laminating presses, plastic tube and rod molding presses, plastic tube rolling machines, plastic-bonded plywood veneer presses.

MODERN PLASTICS will continue to keep its readers informed on all Government orders affecting the plastics industry; and will, from time to time, present news items relative to plastics in defense which it believes will be of interest to all concerned with the production and use of plastic materials. Such news items will be found elsewhere in this issue.

Machinery and Equipment

★ FOR PRODUCING FINISHES ON NONFERROUS metal parts, Globe Machine & Stamping Co. has just developed a new direct motor drive tumbling barrel (above) which may be adjusted to a speed as low as 30 revolutions per minute. The unit is described as more compact than previous models, and is available in either wood or steel shells. The base is cast iron, and all moving parts are lubricated by alemite fittings which feed into grease pockets around bearings and operating shafts. Bronze bushings reinforce all friction spots.

★ PORTER-CABLE MACHINE CO. ANNOUNCES THE development of a 7-in. metal shaper, which is described as a self-contained motor driven unit with motor and speed change control mounted in the floor pedestal. The length of ram travel is $7^3/_8$ in., and the unit is said to operate at any controlled speed from 64 to 175 strokes per minute. A 4-in. diameter tool head swivels 360 deg. and travels $2^3/_8$ in. The ram is $16^1/_8$ in. long by 5 in. wide. The table is 8 in. by 8 in. by $7^1/_2$ in. and has a traverse of $10^1/_2$ in. and a vertical travel of $5^1/_2$ in. Table adjustments may be made by a hand-wheel, and they claim that most adjustments can be made without wrenches; some with a single wrench. Six cross feeds are obtainable from .002 to .012. The unit weighs approximately 485 lb., is about 51 in. high.

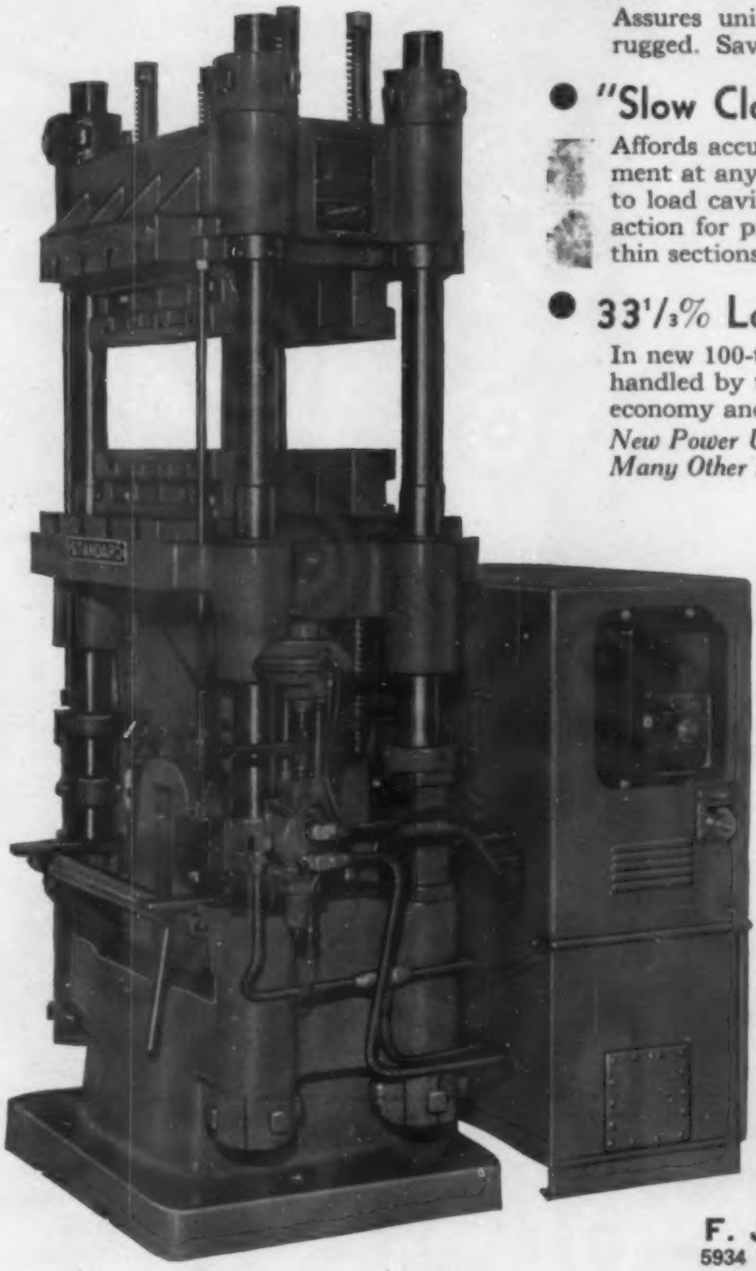
★ "3 INSTRUMENTS IN 1" IS THE WAY HAYS CORP. describes its new Visio-Ratio gage, which is equipped with air-flow, fuel-flow and ratio indicators. This new gage shows the ratio existing between gas-flow and air flow, and the spot at which the pointers cross indicates the exact percentage of the deficiency or excess of air in proportion to the fuel, if such deficiency or excess exists. It is said to be extremely easy for operators to read because it shows relations at a glance, and eliminates the necessity for making calculations to determine air excess or deficiency. The cross pointer feature is also adapted to show the ratio between the flow of gas or oil or other measurable fluid; pressure, draft, suction, temperature (up to 1000 deg. F.), speed in r.p.m., or inches per minute, position and level.

★ A NEWLY DESIGNED INTERCHANGEABLE HAND stamp holder, constructed with a special wedge lock which is said to prevent the individual hand stamps from loosening after continued use of the holder, is being offered by New Method Steel Stamps, Inc. The holder is constructed with a single set-screw which retains all the stamps in position, and the stamps may be locked or unlocked by the single set screw, which is of the socket type. The holder has been designed for use where several numerals or letters must be used to designate the part marked. It is claimed that these holders can accommodate any number of characters and all sizes of stamps.

★ MEAD SPECIALTIES CO. HAS A NEW BANDSANDER (above) for manufacturing plants, workshops, pattern makers and home craftsmen in wood, plastics and metals. In the plastics field, the bandsander is claimed to fill the gap between the band saw and the final polishing operation on projects of almost any size or shape, eliminating the need for saws on many of the smaller ones. The company states that it works equally well on irregular outside surfaces or inside cut-out openings, and will perform carving, sanding and buffing that would otherwise have to be done by hand. The tool is designed to operate at approximately 1750 r.p.m. on motors of $^1/_6$ to $^1/_4$ hp., and can be regulated by means of step-pulleys. The table tilts to a 45 deg. angle to permit beveling on curved or straight edges. Bands up to 1 in. in width and 44 in. in length may be used.

More "STANDARD" Improvements

To Speed-Up Molding Production



- **New Automatic Time-Cycle Control**

  Assures uniform, high-quality moldings. Positive, accurate, rugged. Saves time, labor, material.

- **"Slow Close" Device**

  Affords accurate control of final closing speeds. Slows movement at any desired point in platen travel. Makes it possible to load cavities with a minimum of material. Ideal molding action for precision and insert work or parts with thick and thin sections.

- **33⅓% Longer Stroke**

  In new 100-ton and 150-ton models. Increases range of work handled by these popular-size units. Puts "Standard" speed, economy and high quality into moldings with deeper draw.

New Power Unit Housing; Simplified Seamless-Tubing Piping; Many Other Improvements.

"Standard" Presses are ideal equipment for today's requirements . . . highly productive . . . automatic, except loading and unloading. They mold parts of highest quality, to meet Army and Navy specifications, with minimum rejects. Skilled molders are not required. One operator runs several presses. Human error is eliminated.

"Standard" Presses are preferred equipment for precision molding, delicate insert work, moldings with thick and thin sections or having pins or projections which are liable to damage, button and bottle-cap manufacture . . . as well as for general molding work.

For war production now . . . for economical production later . . . install "Standard" Presses.

For complete description, specifications, etc., of these improved presses, write for new catalog.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road   Olney P. O.   Philadelphia, Pa.

Representatives in New York, Chicago, Cincinnati, St. Louis, Cleveland, Detroit

Pacific Coast Representative: L. H. Butcher Company, Inc.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

In the plastics picture

★ A LONG-RANGE PROGRAM OF COOPERATION BEtween plastics materials manufacturers and the Federal Government was inaugurated by the Plastics Materials Manufacturers' Association at a meeting held at the Mayflower Hotel, Washington, D. C., June 18, 1942. The immediate purpose of the plan is to facilitate wartime buying by Government agencies of parts needed in war equipment by providing those agencies with complete data on properties of plastics, and formulating better test methods and improved emergency standards for specifications of purchase.

The initial step in this direction is a preliminary report covering the properties and characteristics of the following materials: Casein, cast phenolic, cellulose acetate, cellulose acetate butyrate, cellulose nitrate, methyl methacrylate, phenol-formaldehyde, phenol-furfural, styrene, polyvinyl-formals, -butyrals, -acetals, urea for molding compounds and vinyl copolymer resins. This report was issued to representatives of Government agencies and services using plastics and to P.M.M.A. members.

At the request of W. E. Emley of the National Bureau of Standards that the Defense and Government Relations Committee of the Society (consisting of L. M. Rossi, chairman; A. E. Pitcher, J. C. Brooks, E. C. B. Kirsopp) undertake to provide information on plastics for war purposes, a sub-committee was appointed to assist the above-mentioned group in assembling physical data in the laboratories of P.M.M.A. members on all plastics, for presentation to Government agencies. Sub-committee members: J. H. Adams, L. L. Beck, H. K. Nason, H. W. Payne, M. H. Bigelow, W. F. Bartoe, L. W. A. Meyer. The data it has accumulated were only the start of a movement ultimately intended to supply the technical data on various plastics. When the report was completed early in June, various representatives of Government departments and material suppliers were invited to the Washington meeting, which was very well attended (see below). Mr. Rossi presided and the morning discussion dealt with industry problems, attempted to list essential data that were missing and planned the format of the final report which is to be issued when all information is assembled. After luncheon, the meeting reconvened for further discussion.

The results of this meeting were as follows:

1.—A definite well-organized start, attended by the best technical talent in the plastics industry and adequately financed, was made to develop a complete data book on all types of plastics. (It is planned to discuss all the newer plastics not included in the preliminary report outlined above.)

2.—Information will be assembled for Government representatives on the type of data most needed for the war effort and the most pressing problems will be listed. (Data will be assembled on such items as physical tests at extreme temperatures from minus 100 to plus 170 deg. F., the simultaneous effect of high and low temperatures at high humidity on strength and permanence of shape, dimensional stability, softness, brittleness; the shrinkage of plastics over certain heat ranges, mechanical and shearing strength, etc.)

3.—A much better understanding on the part of the Government representatives using plastics for war purposes resulted with respect to understanding the problems and conditions of the plastics manufacturers, and this better understanding was reciprocated on the part of plastics manufacturers with respect to Government problems and war work.

It is expected that the long-range benefit of such cooperation between plastics manufacturers and the Government will result in a better quality of plastics and a more realistic selection according to actual performance.

The Defense and Government Relations Committee is planning a meeting in the immediate future to outline the next step in this program. The regular meeting of P.M.M.A. will be held on Thursday, July 9, at the Manhattan Club, New York City.

Those present at the Washington meeting were:

War Department
- Oliver E. Auer, Engineer Board, Fort Belvoir, Va.
- William Liben, Engineer Board, Fort Belvoir, Va.
- Robert M. McPherson, Engineer Board, Fort Belvoir, Va.
- Capt. Francis K. Wilson, Engineer Board, Fort Belvoir, Va.
- Lt. H. W. Clowe, OQMG
- Capt. Edwin L. Hobson, OQMG
- James R. Owens, OQMG
- Joseph S. Stevens, OQMG
- Frank H. Tupper, OQMG, Temp. B

Naval Observatory
- W. R. Bailey

Navy Dept.
- Robert U. Bonnar, Bureau of Ships
- Ensign R. R. Browning, Jr., Office of Procurement and Material
- Lt. John W. Cox, NAF, Navy Yard, Philadelphia
- J. M. Fenlin
- Lt. Walter R. Fuller, Bureau of Ships
- J. C. Hunter, Bureau of Ships
- N. E. Ruckman, Bureau of Ships
- Henry Sang, Naval Aircraft Factory, Philadelphia
- Lt. Comdr. A. B. Scoles, Navy Yard, Philadelphia
- Ralph W. Stewart, Bureau of Ships
- Jesse B. Lunsford, Bureau of Ships

W.P.B.
- E. L. Burke, Aircraft Branch
- Arthur E. Petersen

National Advisory Committee for Aeronautics
- Harrison C. Chandler, Jr.

National Bureau of Standards
- W. E. Emley
- Dr. G. M. Kline

Wright Field
- Capt. F. B. Fuller, Material Center
- David Grimes, AAF, Material Center
- Lt. R. M. Houghton, Aircraft Laboratory
- Lt. Joseph P. Vidosic, AAF, Material Center

Aeronautical Chamber of Commerce, Washington, D. C.
- Jack T. Gray
- E. W. Morris

Frankford Arsenal
- Major C. H. Greenall

Edgewood Arsenal
- Capt. F. B. Shaw, Jr., Chemical Warfare Service
- Lt. Col. W. F. Sterling, ANMB
- Col. C. V. Morgan, ANMB

Plaskon Corp.
- Dr. M. H. Bigelow

Monsanto Chemical Co.
- John C. Brooks
- Dr. H. K. Nason

Tennessee Eastman Corp.
- L. W. A. Meyer

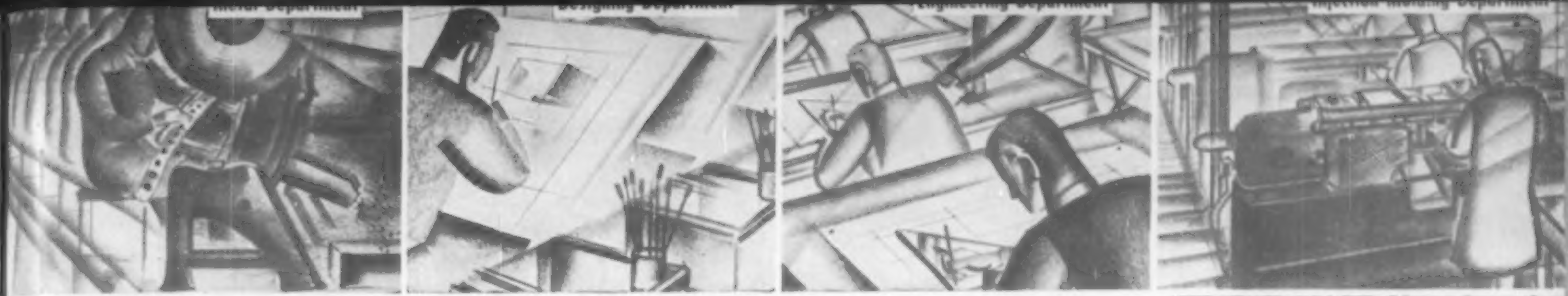
du Pont Co.
- H. W. Paine
- A. E. Pitcher

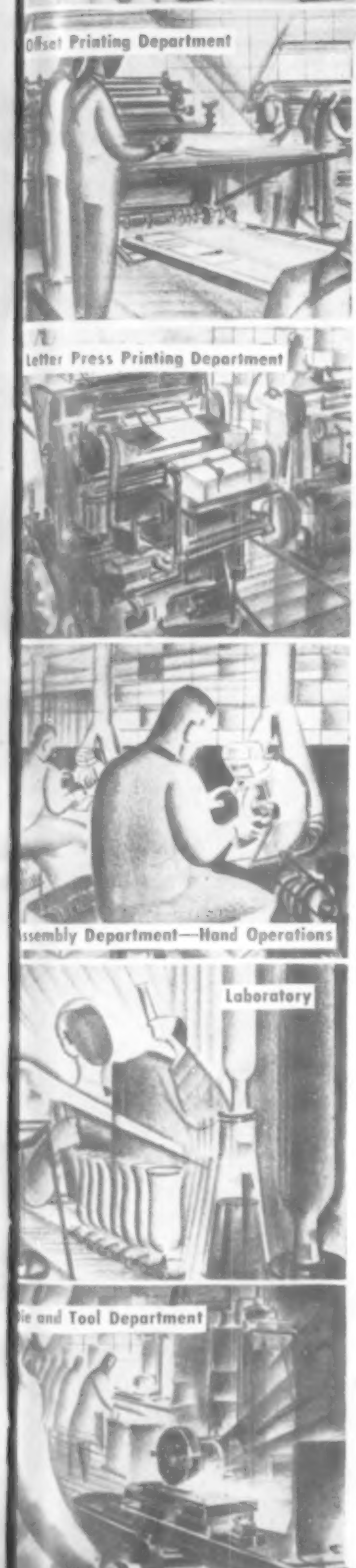
Bakelite Corp.
- John H. Adams
- C. W. Blount
- L. M. Rossi

Rohm & Haas Co.
- Dr. Willard F. Bartoe
- E. C. B. Kirsopp

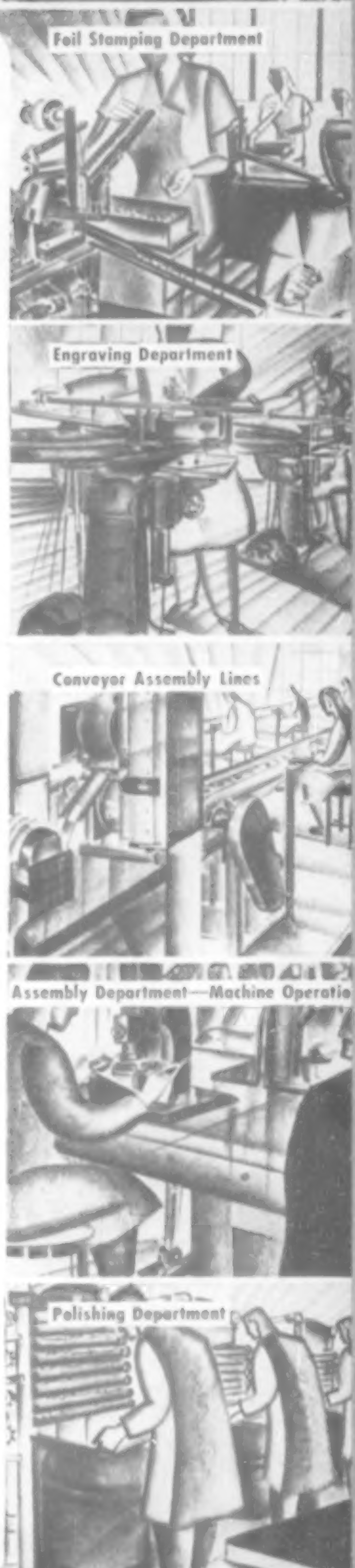
Catalin Corp.
- L. L. Beck

★ THE SPI, AT THE REQUEST OF THE U. S. NAVY, held a meeting at the Bellevue-Stratford Hotel, Philadelphia, on Wednesday, June 10. The purpose of the meeting was to discuss the application of high- and low-pressure molding methods to non-structural and semi-structural aircraft parts. Approximately 40 manufacturers representing both high- and low- pressure methods of lamination attended this meeting, which was opened by Ronald Kinnear, president of SPI. Frank Warner, chairman of the Technical Committee of SPI, presided. Henry Sang, aircraft engineer of the Naval Aircraft Factory, outlined the possibilities of plastics in Naval Aircraft. It was pointed out that because of the urgency of the situation, methods to be adopted would make use of low-cost molds which do not use strategic materials. An exhibit of aircraft parts now made of metal which could possibly use plastics was open to inspection by those present. These were parts of liberal dimensional tolerances; but in the discussion of applications it was pointed out that plastics would have to withstand extreme temperature range,





Offset Printing Department
Letter Press Printing Department
ssembly Department—Hand Operations
Laboratory
ie and Tool Department



Foil Stamping Department
Engraving Department
Conveyor Assembly Lines
Assembly Department—Machine Operatio
Polishing Department

Spraying Department
Modeling Department
Inspection Department
Extrusion Molding Department

possess a high modulus of elasticity and be very resistant to vibration and bearing loads. The meeting reviewed types of laminates and methods of laminating as well as their application to various aircraft parts. Any company wishing to manufacture any of these parts should get in touch with Commander A. B. Scoles, Aircraft Materials Laboratory, Naval Aircraft Factory, U. S. Navy Yard, Philadelphia.

★ ACCORDING TO THE JUNE 4 ISSUE OF THE *Journal of Commerce*, the Wheatfield Chemical Div. of Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., has awarded a contract to the Rust Engineering Co., Pittsburgh, Penna., for the design and construction of a new chemical plant to be located in western New York. Complete with equipment, the new facilities will cost more than $3,000,000.

FRED ZIESENHEIMER

★ THE LESTER ENGINEERING CO. AND THE Phoenix Machine Co. have just formed a new company called Lester-Phoenix, Inc., to act as sole distributors of Lester injection molding machines in the United States. The new company will be located in Cleveland, Ohio, and Fred Ziesenheimer (above) has been appointed sales manager.

★ CARL E. HOLMES HAS JOINED THE ENGINEERING Specialties Corp. as Chief Engineer, and is heading a new and expanded engineering department, designing molds for the plastic industry. He will also do consultation work.

★ THE PLASTICS INSTITUTE HAS ANNOUNCED THE opening of a new office in the Fidelity-Philadelphia Trust Bldg., 123 South Broad St., Philadelphia, where study forum classes will shortly be held. John D. Wearmouth will be manager of the office and J. T. Shoemaker assistant manager.

★ THE BOARD OF DIRECTORS OF THE SPI HAD A meeting on May 22, at which time they adopted formal technical committee regulations and set up six technical committees and divisions. The regulations formulated covered duties of the committee members, organization of committees, appointments of committee personnel, status of committee appointees, committee procedure, rules for special reports, etc. SPI announces that the following committees were set up:

a. Thermosetting Molded Division.
b. Thermoplastic Molded Division.
c. Resin Adhesive Division.
d. Plastics Industry Committee on Laminates.
e. Publications Division.

The following *Governing Technical Committee* was appointed by the President with the approval of the Board:

Frank Warner, Chairman	General Electric Co.
Elmer Maywald, Vice Chairman	Chicago Molded Products Corp.
Dr. M. H. Bigelow	Plaskon Co.
Paul Tietz	The Richardson Co.
E. E. Goodman	Durez Plastics & Chemicals, Inc.
Dr. G. M. Kuettel	du Pont Co.
Dr. W. C. Goggin	Dow Chemical Company
W. A. Zinzow	Bakelite Corp.

The following *Thermosetting Molded Division* membership was designated by the President with the approval of the Board:

Garson Meyer, Chairman	Eastman Kodak Co.
A. Shepard, Vice Chairman	Durez Plastics & Chemicals, Inc.
A. L. Alves	Watertown Manufacturing Co.
Dr. R. D. Barnes (C. Stock, Alternate)	American Cyanamid Co.
Roy Berg	Tech-Art Plastics Co.
Dr. M. H. Bigelow	Plaskon Co.
W. Dunnican	Reilly Tar & Chemical Corp.
H. P. Koenneke	Stokes Rubber Co.
A. W. Koon	Columbian Rope Co.
W. Ross	Diemolding Corp.
Geo. Scribner	Boonton Molding Co.
F. H. Shaw	Shaw Insulator Co.
C. H. Whitlock	Monsanto Chemical Co.
W. A. Zinzow	Bakelite Corp.
Fred A. Morlock	Durite Plastics, Inc.

The following *Thermoplastic Molded Division* membership was designated by the President with the approval of the Board:

Dr. G. M. Kuettel, Chairman	du Pont Co.
W. F. Bartoe, Vice Chairman	Rohm & Haas Co.
B. Anderson	Celanese Celluloid Corp.
L. L. Berry	Erie Resistor Corp.
W. E. Gloor	Hercules Powder Co.
W. C. Goggins	Dow Chemical Co.
E. W. Halbach	Bolta Co.
J. C. Kazimer	Chicago Molded Products Corp.
L. L. Merrill	Union Carbide & Carbon Corp.
L. W. A. Meyer	Tennessee Eastman Corp.
E. E. Mills	E. E. Mills Corp.
W. E. Rahm	du Pont Co.
G. Schmelter	Nixon Nitration Works
E. T. Weibel	Irvington Varnish & Insulator Co.
G. W. Whithead	Monsanto Chemical Co.
W. A. Zinzow	Bakelite Corp.

The following *Resin Adhesive Division* membership was designated by the President with the approval of the Board:

Dr. M. H. Bigelow, Chairman	Plaskon Co.
R. E. Dodd, Vice Chairman	Durez Plastics & Chemicals, Inc.
G. N. Arneson	Douglas Fir Plywood Association
R. Casselman	Bakelite Corp.
A. F. Draper	Langley Aircraft
J. T. Gray	Aero Chamber of Commerce
C. B. Hemming	U. S. Plywood Corp.
N. G. Maloney	Allied Aviation
J. Nelson	General Electric Co.
T. D. Perry	Resinous Products & Chemical Co.
E. C. Pitman	du Pont Co.
H. Rawden	Beech Aircraft
J. M. Stevens	Fairchild Co.
H. V. Thaden	Duramold Corp.
J. H. Tigelaar	Haskelite Corp.
C. F. Van Epps	I. F. Laucks, Inc.
Chester L. Jones	Monsanto Chemical Co.
T. R. Truax	U. S. Forest Products Laboratory

The following *Plastics Industry Committee on Laminates* membership was designated by the President with the approval of the Board:

Frank W. Warner, Chairman	General Electric Co.
Geo. H. Clark, Vice Chairman	Formica Insulation Co.
R. W. Barker	Panelyte Div. of St. Regis
Powel Crosley, III	Crosley Marine Co.
E. R. Dillehay	The Richardson Co.
Alfred A. Glidden	Hood Rubber Co.
E. O. Hausmann	Continental-Diamond Fibre Co.
C. V. Jacobs	Taylor-Fibre Co.
Chas. Marshner	Mc Donald Aircraft Corp.
H. V. Thaden	Duramold Aircraft Co.
O. S. Tuttle	U. S. Plywood Corp.

The following *Publications Division* membership was designated by the President with the approval of the Board: Wm. T. Cruse, Chairman. It will be necessary, as work for this division develops, to augment the membership from several companies.

★ SYNTHETIC RUBBER STARTED FLOWING RECENTLY from a Government-sponsored addition to the Goodyear Tire & Rubber Co.'s Chemigum plant. Reports indicate the new addition, with an annual capacity production of 15,000 tons, will probably be in full operation within a short time, with additional facilities to provide another 15,000 tons annually scheduled for completion this year. As with this company's privately financed original plant, production from the two additional plants is to be confined exclusively to U. S. Army and Navy requirements. The addition just opened will be devoted chiefly to manufacture of tires, although some oil-resistant engine fittings, gaskets and couplings will be made. (*Please turn to page 94*)

★ CONSTRUCTION OF FACILITIES FOR THE MANUFACTURE of Thiokol, a substitute for rubber made by the Dow Chemical Co., Midland, Mich., for the Thiokol Corp. of Trenton, N. J., will be aided by a high priority rating, it was recently announced by officials of the War Production Board. The new facilities will consist of a pilot plant capable of turning out enough of the chemical compound for retreading about 500,000 passenger-car tires per year. Heretofore, Thiokol has been made in relatively small amounts—between 500 and 1000 tons a year—as a substitute for rubber, leather and cork in hose, washers, etc.

★ A NEW PLASTIC CLEANER DISTRIBUTED BY AIRcraft Specialties Corp., 601 S. Anderson St., Los Angeles, Calif., is described as having quick cleaning action on all plastic surfaces. It is said to be harmless to all kinds of plastic materials, and is especially suitable for aircraft assembly of bomber noses, turrets and other plastic parts (see above). Asco plastic cleaner is also intended for use in other plastic fabrication shops.

★ EAGLE ELECTRIC MFG. CO. ANNOUNCES THEIR removal to new quarters after June 15. Their new address is 23—10 Bridge Plaza South, Long Island City, N. Y.

★ PIANO MANUFACTURING PLANTS ARE BEING converted to war production for the duration. The plants, machinery, facilities, administrative and operating personnel of Wm. Knabe & Co., Chickering & Sons, and the Mason & Hamlin Co. at East Rochester, N. Y., have been leased for the duration of the war emergency by Universal Moulded Products Corp. to aid in the manufacture of aircraft for the Canadian and American Governments, it was announced by the office of Arthur E. Pew, president and director of Sun Oil Co., and owner of the controlling interest of Universal Moulded Products Corp. This plan fits into the policy of the WPB of having war contractors utilize wherever possible the facilities of industries curtailed.

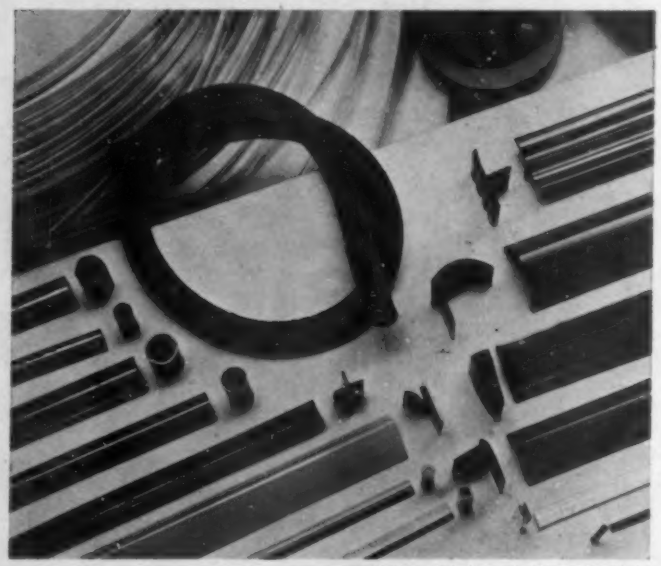
★ POSTWAR PLANS FIGURED LARGELY IN THE DIScussions of 150 members of the Douglas Fir Plywood Association when they held their recent annual business meeting at Tacoma, Wash. Managing Director W. E. Difford pointed out that laboratory and field research and advancement of manufacturing technique must continue, even while the industry is fully engaged in the war effort, if plywood is to hold its ranking place in the building field when peace is established. Additional technicians and new testing machines are now at work in the association's Tacoma laboratory, Mr. Difford said, and field research is being carried on in cooperation with technical and agricultural schools and with industrial concerns.

Production figures were given as being at the rate of 2 billion sq. ft. a year, 90 percent of which goes to war needs.

★ TWO EXPERIMENTAL MODELS OF A BOMBER CREW training plane are being constructed almost entirely of resin-bonded sheets of wood veneer molded over metal forms under heat and pressure, by the Fairchild Engine and Airplane Corp. in Hagerstown, Md. This development is not entirely new, and Fairchild itself has been working on wood planes since 1938. However, the new models are described by company officials as weighing virtually the same as metal planes and are said to have the same "feel" in operation. Metal has disappeared almost entirely from the structure of the plane, and is used only where it is absolutely indispensable for machine-gun fittings, etc. Both steel tubing and fabric covering have been replaced by wood in the fuselage of the new model. The planes are reported as a great advance over previous models because of the improvement of the resin glues, which resist both water and fungus.

★ THE DETROIT, MICH., OFFICE OF HERCULES POWder Co. has been moved to enlarged quarters in the Fisher Building, and the office now includes the Cellulose Products Dept., the Naval Stores Dept., the Synthetics Dept. and the Paper Makers Chemical Dept. Philip F. Robb, formerly in charge of plastics sales in the Cellulose Prod. Dept. of the Wilmington office, was recently transferred to Detroit to act as manager of the new office, at Grand Blvd. and Second Avenue.

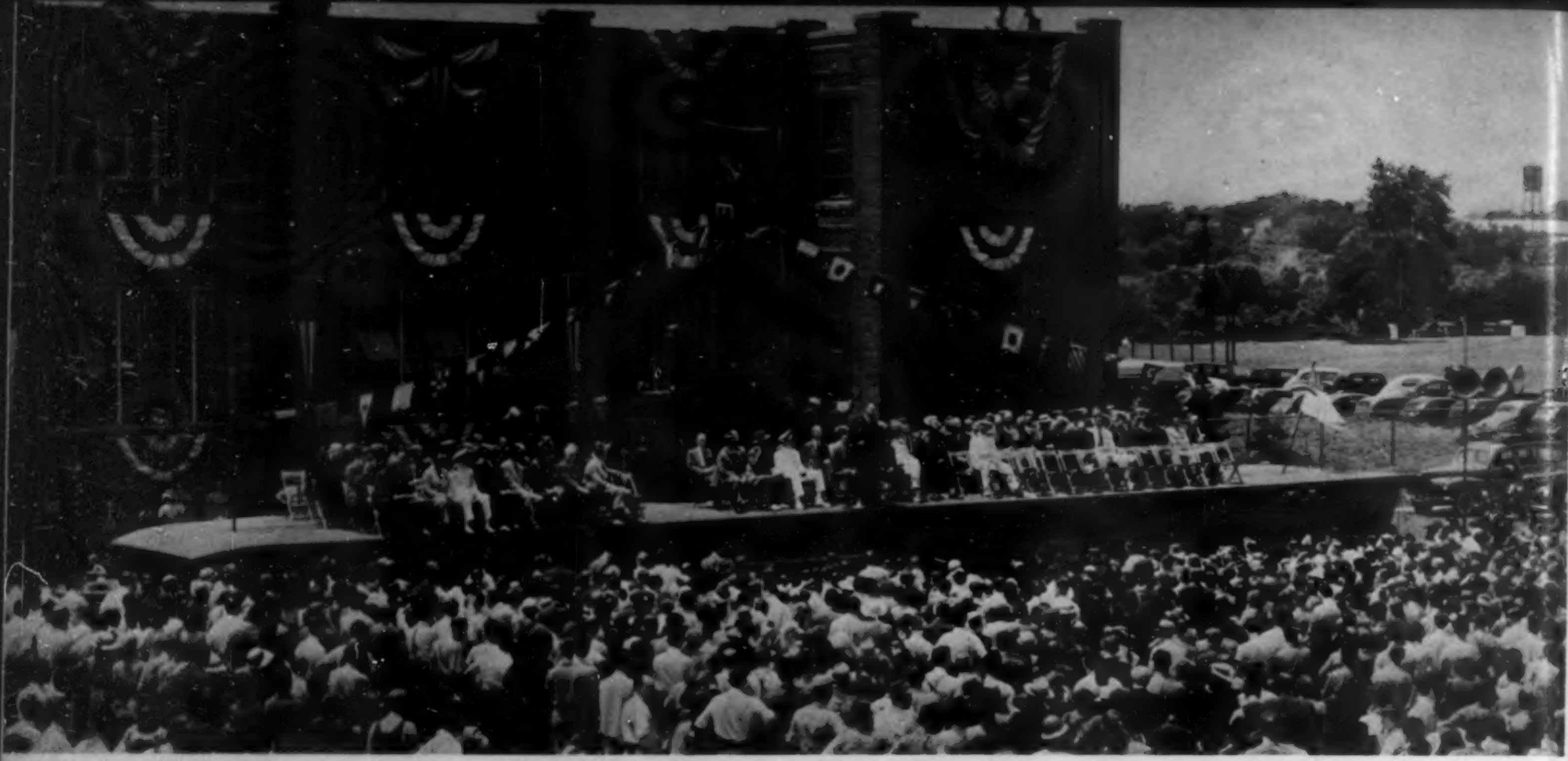
★ H. J. HEINZ CO., OF PITTSBURGH, PENNA., FAMED makers of the 57 Varieties, reports that the company will soon go into large-scale production of airplane parts of plastic-bonded plywood. Analysis of plant equipment revealed that some of the units normally employed in turning out canned food products were "immediately adaptable to specialized work, particularly to the manufacture of plywood airplane parts."



PHOTO, COURTESY CELANESE CELLULOID CORP.

★ A NEW USE FOR EXTRUDED PLASTIC HAS BEEN evolved by R. D. Werner, Inc., 380 Second Ave., New York City, who have developed a piece of perfectly square tubing for use in double hung windows. The square tube, placed between two sheets of plate glass, provides perfect insulation, causing the space between the two sheets to become a dead air space. The tube itself is made perfectly square with a minute flange on one side only to provide exquisite adjustment in spacing. In addition to the square tube, the company has developed a series of rods and tubes, both rigid and flexible. Plastic wire and thread in a wide variety of fineness is also being extruded and, according to the report, one very fine thread is extruded at the rate of 70 miles per hour by means of a special die said to extrude 25 separate threads in one operation. The thread—down to $^{10}/_{1000}$ in.—can be extruded in four different materials suitable for weaving. In the photograph above, all rods are of cellulose acetate except the soft rubbery coil in the center, which is ethyl cellulose.

(*Please turn to page 96*)



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Bakelite flies the Navy "E"

IN recognition of a job "well done," the Navy "E" for excellence in production of Navy matériel, highest award for industrial achievement, was presented to the Bound Brook plant of the Bakelite Corp. on June 19, 1942. The first plastic material supplier to be so honored, the company prepared a special program and luncheon for its distinguished guests, one of whom was Dr. Leo H. Baekeland (Fig. 3, second from left), inventor of Bakelite plastics and one of the founders of the industry.

Particularly impressive was the presentation ceremony which was held on the deck of a 94-ft. replica of the U.S.S. *Yorktown*, constructed after hours by the workers of the Bound Brook plant (Figs. 1 and 2). Rear Admiral William Carleton Watts, U.S.N. (ret.), delivered the principal address, and presented the blue swallow-tail "E" burgee to James A. Rafferty, president of the company (Fig. 3). The pennant may be flown from the Bound Brook plant's mast for six months. At the end of that period, the Navy Board for Production Awards will review the plant production record, and if it is found to be up to the "E" standard, a white star will be added to the pennant for an additional six months of outstanding production.

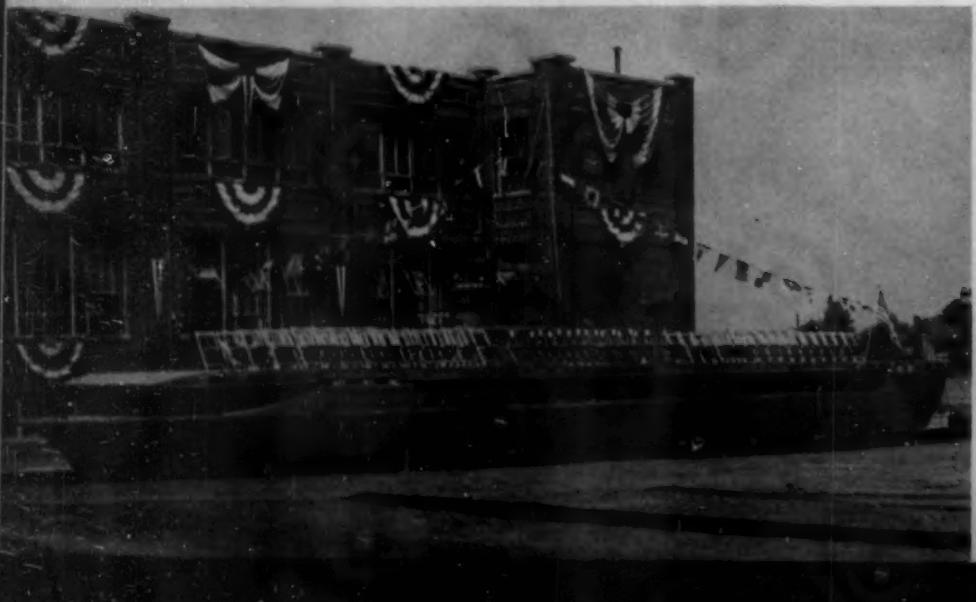
In addition, Commander E. C. Forsyth, U.S.N., presented the employee "E" insignia to J. P. Dunn, president of the Employees' Union, who represented all of the plant employees. Each employee will be permitted to wear a button featuring the "E" insignia for the length of time that the pennant flies. Other speakers on the program included the Honorable Charles A. Eaton, U. S. Representative from New Jersey; Rupert B. Lowe, Bound Brook works manager; and L. M. Currie, superintendent of the plant's division which produces Vinylite resins and plastics.

Although the pennant was presented to the Bound Brook plant, all of the affiliated branches of the Bakelite Corp. have cooperated in achieving the results that earned the award.

The Navy "E" is not lightly bestowed nor easily earned. It represents the Navy's highest award for industrial achievement in the production of Navy essentials, and its granting is based on a variety of factors such as the comparison of production figures with contracted schedules, ingenuity in manufacturing methods, suggestions for design changes to speed production, cooperation with Navy personnel, and relations with labor.

Following the presentation of the pennant, which was raised by the Color Guard of the Bound Brook Sea Scouts, it was announced that the Bakelite Information Center was to be opened in connection with an educational program for the employees. The Information Center will contain finished products making use of plastics and resins produced by the company. The program is dedicated to the principle of keeping employees informed of what they are contributing to the war effort by enabling them to see their own work as part of the whole picture.

2



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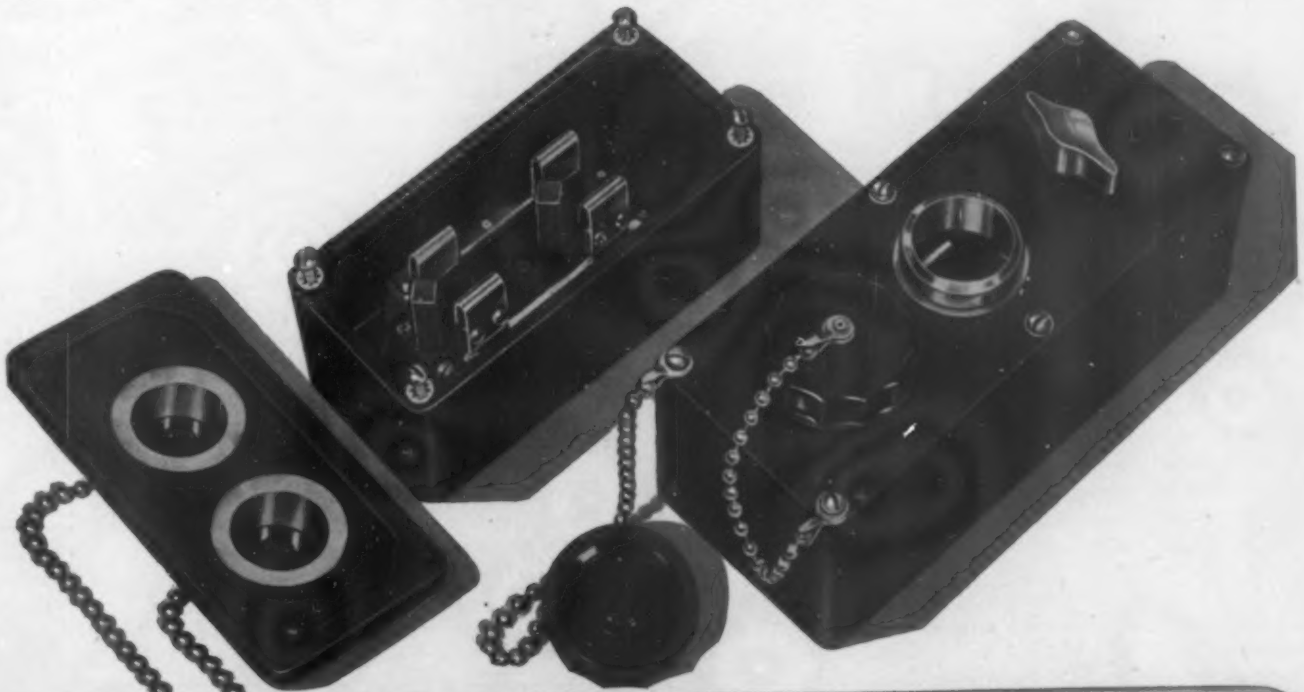


..........WASHINGTON NEWS..........

PROPOSED MACHINERY ORDER

It is rumored in Washington that deliveries of all plastic molding machinery may be halted within 30 days after the issuance of a priority order now before the Clearance Committee of the Bureau of Priorities. We have been told that this order may be promulgated within the next few weeks, although thisi nformation has not to date been confirmed.

Under the terms of this proposed order, compression, injection, plywood hot presses and other types of molding equipment (with the exception of plywood cold presses) would be covered. In the form in which it was submitted to the Clearance Committee, we understand, the order provided that all plastics molding machinery would have to be completed and delivered within 30 days after the issuance of the order. Otherwise, it would be "frozen." Even in the case of "approved" orders (i.e., priority rated orders), if the machinery were not delivered within the 30-day period, special permission of the Director of Industry Operations would have to be obtained before deliveries could be made.

It should be made clear, however, that the order will probably refer only to completed machinery. Any parts necessary for the maintenance or repair of existing machinery may still be manufactured and delivered under authority of the Maintenance and Repair Order, P-100. Such orders bear a preference rating of A-10. But, if tool steel is needed to fill such orders, all previous priority orders and regulations stipulating the amount of high-grade alloy steel that may be so used must be observed.

PLASTICS FOR CLOSURES

A new business opportunity has opened up for the plastics industry with issuance of an order by WPB practically prohibiting metal closures on distilled wine and spirit containers after August 1. Last year, according to an estimate of a WPB official, the entire glass-container industry used about 15,000,000 lb. of plastics split about 70 percent phenolics and 30 percent ureas.

However, several hitches in more extensive use of plastic closures appear. One is that the molding capacity of the industry on the standardized volume basis required in closures is doubted to some extent by the container industry. Another is that phenolics are short, and in the formaldehyde order closures are classed as B-4 usage.

This, of course, rules out use of any phenolics, since at least an A-10 is necessary in that material. Although ureas are presently plentiful, if a vastly increased closure program is piled on top of other plastics demands on ureas, it will probably make them scarce, too; and the same B-4 classification would arise to prevent manufacture of closures made from ureas.

The plastics and containers industries should get this barrier removed. It doesn't make much sense, since an A-1-a rating has been granted in most cases for obtaining scarce metal for metal closures up to this time.

Wine and spirits experts estimate that the requirements for plastic closures will increase about 25 to 30 percent above the 15,000,000 lb. used last year as a result of the forced shift to plastic closures in bottling wines and spirits.

PHENOL ALLOCATIONS

★ UNDER THE NEW SYSTEM OF PHENOL ALLOCAtion soon to go into effect (described in the June issue of MODERN PLASTICS, page 93), all requirements for phenol and other tar acids for the following month's consumption must be in Washington on the 15th of the month, when these chemicals are formally allocated. This, of course, means that resin producers must close their books about the 10th and calculate their requirements.

Under this system, it is the responsibility of the molder, laminator, plywood manufacturer or other user of resin or resinous compounds to see that his customers send him their orders in time for him to place his requirements with his vendors by the 10th. This is not an arbitrary decision, but a practical plan to insure that the plastics industry will receive its fair share of phenol and other tar acids, since other industries will also be requesting supplies of these chemicals.

Unless the plan is followed carefully, even on orders carrying high preference ratings there is grave danger of delay in shipment of materials and parts if customers do not place their orders in time for them to be included in the lists of requirements that come up for allocation in Washington on the 15th of each month.

GOVERNMENT ORDERS & REPORTS

★ WITHIN THE PAST SIX WEEKS THE INCREASED momentum of the nation's all-out war effort has resulted in a corresponding increase in shortages of essential raw materials. The relative scarcity of these materials has been reflected in the reports and allocation orders emanating from the office of the WPB within the past week, and many of these are of vital concern to the plastics industry. *(See Thermoplastics order, opposite page 64.)*

The third report issued by the Conservation and Substitution Branch of the Bureau of Industrial Conservation (WPB-1254) reveals that supplies of more than 40 additional materials have become so scarce in relation to wartime demands that WPB now considers them either inadequate for war and essential uses or barely sufficient. Following the arrangement of previous reports (See MODERN PLASTICS magazine, May 1942, page 92), this latest release lists materials in three groups according to their availability for substitution or use in civilian industry. In the first group are the critically needed materials not sufficient for war and essential civilian uses and in many cases inadequate for war purposes alone. These (of interest to the plastics industry) include acetone, alkyd resins, aniline, benzol, butadiene, chlorinated hydrocarbon solvents, chlorine, cresols, methyl methacrylate sheets, naphthalene, phenol, phenol-formaldehyde resins and plastics, phosphates, phthalic anhydride and phthalates, polystyrene, polyvinyl chloride, toluol, cotton duck, cotton linters, natural resins except rosin, synthetic rubber, chlorinated rubber, shellac.

The second group contains many scarce items the production and use of which are evenly balanced but the supplies of which are not as limited as those of group one. Some of the chemicals and plastics included in this group are ethyl and methyl alcohol, butanol, formaldehyde, methyl methacrylate powder, urea-formaldehyde plastic, vinylidine chloride plastic, castor oil, cellophane, cellulose nitrate, acetate and other derivatives, vulcanized fiber, wood pulp.

The third group, listing materials generally available in quantity as substituted for less available material, contains practically no metals and chemicals. Some of the products included in this group are lignin plastic, raw cotton up to $1^3/_8$ in., gilsonite, glass, soybean protein, wood sawdust, wood fiber, woodflour.

Commenting on the availability of materials for substitute purposes, the Bureau noted: "The third group, listing materials in quantity, is practically void of metals and chemicals. Most of its items are used with little change from the condition in which they are mined, quarried or grown. Even where there are almost unlimited supplies, as of lumber, oil and cotton, certain varieties or grades have become scarce. Further, in the case of large tonnage items, the problems of labor, manufacturing and transportation have become increasingly important in making the materials available."

(Please turn to page 100)

MODERN METHODS OF MARKING

Meet the Navy's marking requirements

for plastic nameplates, terminal strips, panels, etc.

The Navy directive to replace metal with plastic nameplates . . . to conserve critical metals and to speed execution of war contracts . . . designates them for machines, equipment, appliances. Contractors and subcontractors are affected.

Work produced by the Markem Husky 6 Embossing Machine meets the Navy's expressed preference for indentation, with or without color, for permanency. Production is rapid, economical. Adapted to quick marking changeovers for variable work and to designated types of plastics.

* * *

Other Markem methods and equipments identify, inform, instruct. They help assemble, route, handle, find, fit, reassemble. They help to get battleship parts and ski troop goggles from factory to front.

* * *

Here in the foothills of New Hampshire is readiness to help meet changing conditions. Adaptable, versatile, speedmarking methods and equipments for difficult, unusual, bottleneck marking and trademarking problems are at your service for marking better, faster, at less cost.

We are at it twenty-four hours a day to keep up with incoming orders, but if we can know in advance of your conversion marking needs, we'll try to help. Priorities of A-9 or higher are necessary for manufacture and shipment. Markem Machine Company, 60 Emerald St., Keene, New Hampshire.

MARKEM PLASTIC PRINTERS

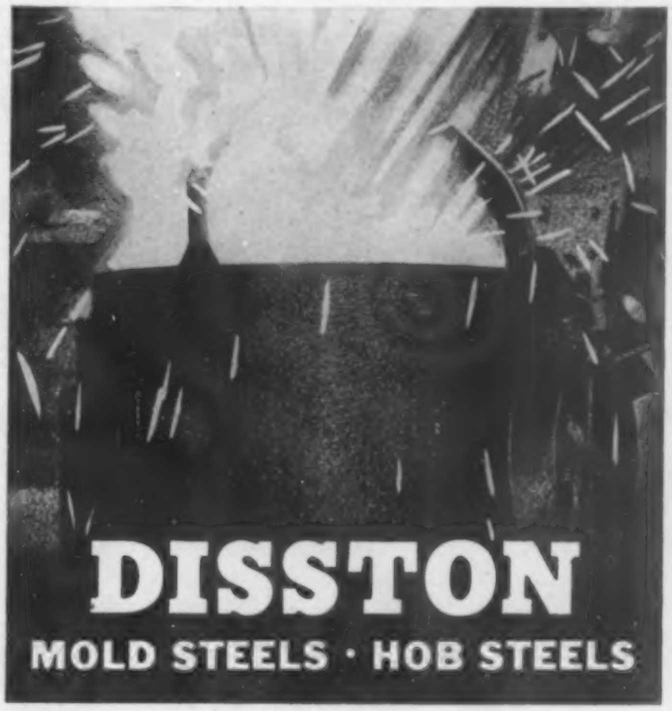
make certain that your molder is MARKEM equipped

Fewer rejects—more production with molds and hobs of

DISSTON STEEL

Four special Disston Steels . . . carefully manufactured in modern electric furnaces to meet the most exacting requirements of plastic molding . . . will help you to reduce your percentage of rejects and to speed up your output.

Whether you make molds and hobs, or use them, you'll find that it pays to specify Disston Steel of the right grade . . . steel that's uniformly sound, with no hard spots or spongy areas.



● **DISSTON PLASTIRON** is a clean, soft iron that carburizes easily, produces smooth cavities, and is best adapted to short runs and difficult shapes.

● **DISSTON PLASTALLOY** combines great core strength and abrasion resistance with ease of hobbing. Cavities are tough and resist wear.

● **DISSTON NICROMAN** is ideally suited for forces, punches and machined molds because of its extreme toughness, abrasion resistance and long-wearing life.

● **DISSTON CROLOY** has uniformly high hardness, great compressive strength, wear resistance and core strength. It is your best choice for long runs and extremely precise part production.

Our metallurgists will be glad to help solve any specific problems you may have involving mold and hob steels. Write today to Henry Disston & Sons, Inc., Philadelphia, Pa., U. S. A.

★ AN ORDER FOR 1,700,000 PLASTIC RAZORS, THE first of this type ever purchased by the Army, was issued recently by the U. S. Army, Jersey City Quartermaster Depot, with delivery scheduled for Sept. 1. Of the total number ordered, 300,000 will be all-plastic, with the exception of the screw section in the head of the razor, which will be metal; the remaining 1,400,000 will be a combination of plastic and metal, with the guards and handles to be made of plastic. The new razors will be manufactured with a thermosetting plastic used for the cap and guard; a thermoplastic material for the handle and box. The specifications call for a box of the self-closing, hinged or sliding type, formed from black virgin molding material—cellulose acetate, cellulose acetate butyrate or ethyl cellulose—having a wall thickness of not less than .100 in. and provided with suitable compartments to hold the razor and package of blades snugly in position. The change to plastic razors will effect a considerable saving of brass, nickel and other critical metals.

★ TO PROVIDE ADEQUATE SUPPLIES FOR MILITARY and essential civilian use, ethyl cellulose was placed under complete allocation control by General Preference Order M-175 issued by the Director of Industry Operations on June 18. By the terms of the order no person may deliver, and no person may accept delivery of ethyl cellulose except by specific authorization of the Director of Industry Operations. Deliveries up to 50 pounds in any one month are excepted. Orders for quantities exceeding 50 pounds must be filed with producers on or before the 15th of the month preceding the month in which delivery is desired, accompanied by Form PD-550. Producers must file with WPB on or before the 20th of each month, beginning with June 1942, Form PD-549 showing a schedule of deliveries and a statement of the amount of ethyl cellulose available for delivery in the succeeding month. Although production of ethyl cellulose is now larger than ever before, orders carrying preference ratings of A-10 or higher are drawing off stocks for which comparatively plentiful nitrocotton, pitch, tar or other substitutes are available. This order is issued to prevent the use of ethyl cellulose in places where substitutes are available.

★ SIX CHEMICALS WERE PLACED UNDER COMPLETE allocation control on May 30 by the Director of Industry Operations. The order numbers, chemicals and date allocations are:

Order M-163, byproduct ammonia and sulfate of ammonia, June 1; M-164, synthetic ammonia, June 1; M-165, cyanamid, June 1; M-167, capryl alcohol, July 1; M-168, isopropyl alcohol, July 1; M-169, methyl ethyl ketone, July 1. Manufacturers and retailers of fertilizer and their agents are not included in this restriction. Producers and distributors of these chemicals are required to file Form PD-237 prior to the tenth day of each month beginning with June.

★ GENERAL PREFERENCE ORDER M-171 ISSUED June 1 by the Director of Industry Operations places all chlorate chemicals under complete allocations. Chlorate chemicals are used normally for making matches, fireworks, explosives, for killing weeds, oxidizing and preventing rust, and in a variety of chemical processes.

★ AN AMENDMENT TO LIMITATION ORDER L-20 issued recently by the Director of Industry Operations further restricts the use of cellophane. The order as amended covers cellophane or other transparent cellulose sheets of .003 in. or less. The original order covered sheets of .005 in. or less. A new plastics conservation order is being drawn which will cover use of sheets over .003 in. in thickness. Further restrictions imposed by the new amendment prohibit use of cellophane in window cartons, for carton overwraps, for packaging animal foods, rubber nipples and candy. Conservation of cellophane under this order is to avert a shortage of military and essential supplies, as well as to conserve wood pulp, sulfuric acid, plasticizers, chlorine, glycerine and caustic soda, all critical products which must be conserved for war production.

★ CHEMICAL COTTON PULP WAS PLACED UNDER full allocation control by WPB Conservation Order M-157, issued May 28, 1942, effective July 1, 1942. No producer may deliver, no buyer may accept any chemical cotton pulp except as specifically authorized by the Director of Industry Operations. Exceptions to this are deliveries to the Army, Navy, Coast Guard and Maritime Commission, and small orders of 500 lb. or less to any one consumer per month provided total of such small deliveries is less than 2000 lb. per month by any one producer. June deliveries are not affected. Chemical cotton pulp, which is chemically treated cotton linters, is pure cellulose used for manufacture of smokeless powder, rayon, plastics and important products.

★ ON MAY 28, 1942, ALL GRADES OF BUTYL ALCOHOL were placed under complete allocation control through issuance of General Preference M-159 by WPB. Allocation will start on July 1. Butyl alcohol is used in the manufacture of explosives, plastics, paint, protective coatings and brake fluid.

★ ON MAY 30, THE WPB COMPLETELY PROHIBited the use of blackplate after August 1 and all tin effective at once in the manufacture of closures for wine and distilled spirits by issuance of M-104 as amended. In addition, WPB enlarged the list of other products for which the use of tinplate or terneplate covers is prohibited. After June 1, the use of blackplate in closures for beer and non-alcoholic beverage bottles is to be limited to 60 percent of the tonnages used for the same purposes in 1941. However, manufacturers who in 1941 packed beer in flat-top cans and in cap-sealed cans will be allowed, roughly, the use of 3 additional blackplate closures for each 5 cans used in 1941.

★ BECAUSE OF THE RAPIDLY GROWING DEMAND for benzene in making aviation gasoline, synthetic rubber, phenol for plastics and aniline for the high explosive tetryl, the WPB placed benzene under complete allocation control on June 1 by the amendment of General Conservation Order M-137. It is deemed necessary to prohibit delivery or acceptance of any benzene after July 1, 1942, except by specific authority of the Director of Industry Operations. Quantities of 50 gallons or less to one person in one month are excepted.

Subject to the provisions of General Preference Order M-34 (Toluene), producers of benzene must operate their equipment to obtain the maximum quantity of two-degree benzene possible. The Director of Industry Operations may from time to time direct that maximum production of benzene of some other grade be produced. Sale is permitted of coal tar derivative oils (petroleum oil not included) containing benzene only when the purchaser is prepared and equipped to extract the maximum amount of benzene possible. Further provisions of the order prohibit the use of benzene as a motor fuel, either pure or in mixture, or its sale when the seller has reason to suspect that it may be so used.

★ BY GENERAL PREFERENCE ORDER M-170, WPB places styrene, a basic material needed for synthetic rubber manufacture, under complete allocation control. Purpose of the new order, the board said, is to insure delivery of necessary amounts of this material to synthetic rubber plants without prohibiting use of surplus styrene in manufacture of plastics, such as combs, buttons and certain types of electrical equipment. Under terms of the order, all producers are directed to submit monthly delivery schedules to the WPB to be approved or modified by the Director of Industry Operations "at his discretion."

★ WPB ON JUNE 1 ORDERED PRODUCTION OF LUXury cutlery items such as domestic carving sets, pocket knives and manicuring implements halted after June 30 and restricted output of more essential articles such as household cutlery. WPB estimates the order will effect an annual saving on cutlery items of about 6000 tons of iron and steel, including 2000 tons of stainless steel, 600 tons of copper alloy and various small amounts of nickel, chrome, aluminum, antimonial lead, rubber and plastics.

(Please turn to page 102)

★ BENZENE WAS PLACED UNDER COMPLETE ALLOCATION control by a June 1 amendment to Order M-137. Because of the increased demand for benzene for making aviation gasoline, synthetic rubber, phenol for plastics and aniline for high explosive tetryl, delivery or acceptance of any benzene after July 1 except by specific authority of the Director of Industry Operations has been prohibited. Quantities of 50 gallons or less to a person in one month are excepted.

★ AN AMENDMENT TO GENERAL CONSERVATION Order M-56 issued on June 5 by the Director of Industry Operations lifted the restrictions on the uses of natural resins in the manufacture of playing cards, pencils, house paint, label varnishes, toys and farm equipment finishes.

★ ANOTHER STEP TOWARD STRICT ALLOCATION OF scarce materials and improved control of inventories was taken on May 30 in an announcement by Industry Operations Director Knowlson that all but a few classes of companies requiring more than $5000 worth of metal for the third calendar quarter of 1942 must apply for priority assistance under the production requirements plan before July 1. Under the production requirements plan, preference ratings will be assigned only for specified quantities of materials to be obtained during a calendar quarter. This will enable the WPB to determine in advance of each quarter the total quantities of material required by industry, as well as to estimate available inventories in the hands of manufacturers.

★ A UNIFORM POLICY TO BE FOLLOWED IN CONSIDERATION of all appeals for permission to continue production which has been halted by WPB conservation and limitation orders was announced by the War Production Board on June 2. Appeals will be considered for the assembly of processed or semi-processed inventories beyond cut-off dates or in excess of limitation quotas. In general, such appeals will not be granted except when materials involved have already been fabricated to such an extent that their use as scrap would be grossly wasteful.

★ AFTER JUNE 20, COATINGS CONTAINING CERTAIN organic binders or pigments may not be used for coating steel containers of 2 gallons or greater capacity by the terms of General Conservation Order M-158. Coatings are divided into "Class A" and others. Class A coatings, containing tung, oiticica, perilla or dehydrated castor oils; alkyd, phenolic, vinyl, urea or melamine resin; or cellulose esters or ethers, may not be used for drum coatings after June 20 except for export (the export exception does not apply to Class A coatings containing tung or oiticica), or orders for the Army, Navy, Coast Guard or Maritime Commission.

★ ALL GRADES OF BUTYL ALCOHOL WERE PLACED under complete allocation control on May 28 by General Preference Order M-150. Allocation will start on July 1. Butyl alcohol is used in the manufacture of explosives, plastics, paint, protective coatings and brake fluid.

★ UNDER LIMITATION ORDER L-144, UNIVERSITY and other private laboratories will be unable to obtain scientific equipment requiring critical material unless their research is related to the war effort. The only exception is for research approved by the Director of Industry Operations.

★ CONCENTRATION OF PRODUCTION OF GIVEN sizes of anti-friction aircraft control and pulley bearings in specified units of the group of companies making them has been ordered, it was stated by the OEM on June 15. Through this concentration, a considerable savings in time formerly spent in setting up and taking down production machinery, and the release of many hours of highly skilled machine setters' time is expected.

★ TO PROMOTE SPREAD OF ORDERS, SPEED IN DELIVERY and wider use of existing facilities, the War Production Board has issued Directive No. 3, providing for renegotiation of Government contracts of the "open-end" type used in peacetime. These contracts require a Government agency to purchase all of its requirements of a specified article from one company over a definite period of time. In some cases, wartime needs for articles which the Government has agreed to purchase from one company under an "open-end" contract far exceed the amounts contemplated when the contracts were originally signed, and participation of other companies is desirable to obtain faster delivery and to use facilities of smaller companies otherwise not used.

★ ORDER M-157 ISSUED MAY 28 BY THE DIRECTOR of Industry Operations placed chemical cotton pulp under full allocation control. Effective July 1, no producer may deliver, and no buyer may accept, any chemical cotton pulp except as specifically authorized by the Director of Industry Operations.

★ THE NEW PRODUCTION REQUIREMENTS PLAN IS the beginning of a development whereby preference ratings will be granted only for a specific amount of material. Use of PRP has now been made mandatory for almost all companies using more than $5000 worth of critical metal in a quarter, including Government shipyards, arsenals and munitions factories. Control over metals and other scarce materials is becoming stricter while use of preference ratings is simplified by an amendment to Priorities Regulation No. 3, which provides a single form of certification on purchase orders bearing a preference rating.

★ UNDER THE TERMS OF AMENDMENT NO. 1 TO THE chemical industry's repair and maintenance order P-89, an A-1-c rating may be used to obtain 30 percent of a chemical producer's regular operating supplies, with an A-3 rating available for the remaining 70 percent. The original order granted an A-3 rating for all such supplies. A-1-a rating for supplies to repair an actual breakdown, and the A-1-c rating for repairs to avert an immediate threatened breakdown are held over from the original order.

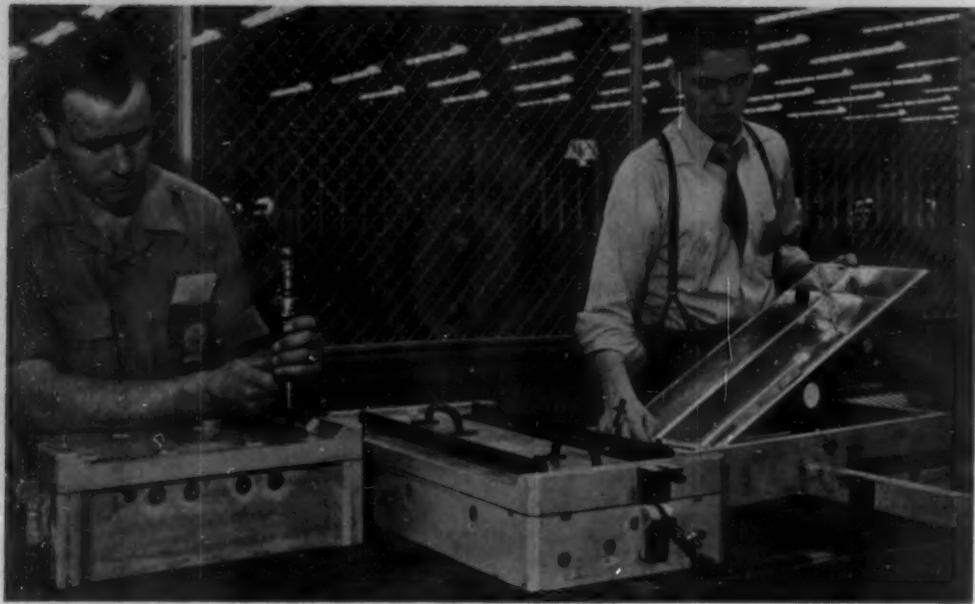
★ THE BASIC IMPORTANCE AND ECONOMY OF AN intelligent salvage program in every type of plant was discussed at the salvage conference held under the auspices of the American Management Association at the Hotel New Yorker, New York City, on June 17. S. Donald Perlman, Salvage Director, Textiles, Plastics, Solvents, War Production Board, said: "If 15 to 20 percent of the available plastic scrap were used, the poundage of plastics would be increased by one million pounds per year." Mr. Perlman urged plastic users to investigate the possibilities of their own scrap materials for re-use, and stressed the importance of reclaiming solvents.

WPB QUESTIONNAIRE NO. 1251 ON PLASTICS

The Bureau of the Census (acting as the collection agency for WPB) is sending out questionnaires to the plastics industry. It is exceedingly important that all questions be answered completely and promptly to enable the various WPB divisions to have an up-to-date picture of the plastics industry as a whole. Should any compression, injection, extrusion or cold molder of plastics materials fail to receive a copy of this questionnaire, he is requested to write immediately to the Bureau of the Census, Washington, D. C., and ask for WPB Questionnaire No. 1251.

Since important decisions affecting the industry may be based on figures and data contained in these questionnaires, it is essential that the industry cooperate to the fullest extent. A supplementary questionnaire to determine quantities of the different materials going into various end products may be sent out later.

12



12—*Mounting shortage of metals is steadily increasing the rôle of plastics in the war effort. Light, strong cast plastic tools are both popular and efficient. These drill jigs in metal would be ponderous, hard to handle, and more costly than the plastic; tests demonstrate that they function as well in plastic materials*

Tools for aircraft

(Continued from page 37)

Molds for all types of bases. The advantages of plastic tooling are more pronounced in tools that require fitting to contours than those used for straight surfaces. On formed router blocks, for instance, it is much simpler to make a form using the sample part as part of the form and casting a base, than to blue it in and work it down by hand.

There are two methods by which this mold can be made. One is to back up the part with clay or plaster and build the sides of the mold around the part, extending the flanges with plaster to allow a larger base or nesting block than the sample part itself. Another method is to use the sample part as a pattern and make a complete mold from the part. On large castings it is often advisable to use the plaster from which the zinc alloy die was made to obtain the contour. When this is done, a splash is made of the plaster and the sides are built up of wood. It is better to use wood for the outsides of molds whenever possible, because wood contains far less moisture than plaster and allows rapid penetration of heat. This insures a cured casting. In many cases, the surface that is to be next to the part can be cast on plaster while the outer surfaces can be cast against wood and later sanded.

If plaster is to be used entirely for the mold, the volume of plaster should never exceed the volume of the casting. Mold thickness should always be kept to a minimum. The reason for keeping them thin is best explained by the action that takes place When the reaction between the resin and the catalyst takes place, heat is created. The more volume we have in the casting, the more heat is formed. Thus, in a small casting, only a small amount of heat is created, and the casting is forced to depend on oven heat to finish its cure. If a small casting is encased in a thick plaster mold, it takes oven

13—***Aircraft worker wears transparent plastic protective mask while milling cast resin nesting block.*** **14**—***Sheet metal department operator inspects completed metal part which was formed in hydropress over a cast resin die (left)***

13

14

heat some time to penetrate the plaster. Thus, in many cases, in order to cure the bottom of the casting, it would have to bake so long that the top, which is exposed, would be overcooked. Molds of any material should be made in such a manner that they can be easily sprayed and then assembled and poured.

Treating the molds. All plaster molds should be treated with one coat of bayberry wax, let dry and sprayed with at least four coats of clear lacquer, sanding between the last two coats. The lacquer must be thoroughly dry before pouring with plastics. Wood molds should be coated with four coats of clear lacquer, sanding after the first one. The last coat should be absolutely smooth. Regardless of the material used in the mold, the casting will reflect every detail of the mold surface.

Drill jigs. The above procedure outlined for base molds holds true for all types of jigs. Drill jig bases fall in the same category as formed router block bases. In many cases it is desirable to use plastic bases and some other form of drill plate.

Weight is an essential factor to be considered in all tools. Bases should not be under $^1/_2$ in. or over $2^1/_2$ in. thick. On extreme contours, the bases should be made in the form of a shell. Bases should always be backed up with $^1/_2$-in. Masonite to absorb the jar in handling and protect the edges. In the case of a shell for a base, the shell may be fastened to the Masonite at points of contact. For attaching wood or Masonite to plastics, coarse-threaded machine screws are recommended. Holes are drilled and tapped as in steel. Machine screws should be as long as possible.

When using a thermosetting plastic drill plate, never cast the bushings directly in the plastic. Cast the plate blank and back drill from the sample part or master part, locate the bushings and set in cerromatrix. One precaution is vitally important: When pouring the cerromatrix, be sure that it is not too hot, or it will expand and crack the plastic; 300° F. is the proper temperature for pouring.

No design for plastics should include sharp corners or protruding angles or flanges that may be knocked off or chipped in use. All radii should be as large as is permissible on the particular tool. Outside radii that have no bearing on the function of the tool should be at least $^3/_8$ in. These may be sanded in some cases. Allow generous fillets. Sharp corners, are weak points. Wall thickness should always be $^3/_4$ in. or more. Drill plates that are poured with a constant wall thickness should be poured from one end, baked and left in the mold to cool. Thin sections poured from the flat side will warp.

Hold downs. Any standard type of hold downs may be used, always bearing in mind the fact that when the clamps are closed or tight, the plate should be resting solidly against the base and yet not have the drill plate in a strain.

Drill bushings. Plastic hex bushings are available and are recommended where space is not cramped. In the event that space is limited, use gang bushings.

Marking plastic jigs. Wherever possible, jigs should be stamped on the Masonite base. When this is not convenient, and it is necessary to stamp the plastic, it should be done with a rubber stamp using India ink. When the final coat of lacquer is applied (which should be the last operation before inspection on all plastic tools), it seals the ink so that it cannot be rubbed off.

Plastic form blocks. All plastic hydro form blocks should be mounted on a Masonite base projecting all around the block $^1/_2$ in. On blocks that are to be 2 in. high, the plastic should be poured $1^1/_2$ in. thick. On thicker blocks, 1-in. Masonite should be used. Blocks should be standard 2 in., 3 in. and 4 in. If a wood pattern is made, it should be made to shrink scale. The shrink of the oil tool resin now being used is $^1/_{10}$ in. to the foot. A plaster splash is made of this pattern and the splash used as a mold.

Mixing the resin. The mixing of the resin must be thorough. If the catalyst is not well mixed, there may be spots in the casting that will not set up. Also, if the fillers are mixed with the resin before the catalyst, the fillers will absorb some of the catalyst and form lumps of catalyst-soaked filler

15—*The chemist plays a starring rôle in behind-the-scenes research. His experiments and preparation fix the optimum proportions of various materials to achieve the best results. Knowledge of the specific properties of all plastic materials (see wall chart) is indispensable to the efficient operation of an industrial laboratory*

TABLE ROUTER
for
War Production Plants

DIRECT DRIVE

All Power Right at The Bit

3 H.P.

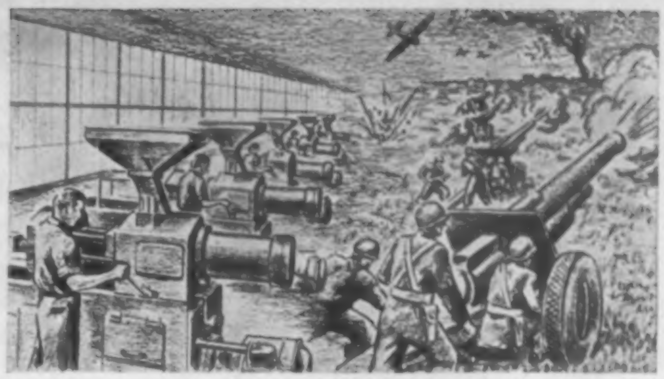
Speed 15,800 R.P.M.

The Carter TR2A Table Router meets wartime requirements for routing of aluminum, wood, "Plexiglas" and similar materials used in aircraft plants, navy yards and other war production centers.

Motor is universal type, operating on either D.C. or A.C. current, 25 to 60 cycles. Equipped with automatic sentinel type switch. Routing Bit is driven directly from the motor shaft which does away with all gears, belts, chains or any auxiliary drives—nothing to consume power, give trouble or slip.

A wide range of standard size Carter Bits is available for use in the TR2A Router for veining, panel-sinking and other routing cuts. Write for complete details and description. **R. L. Carter Division,** The Stanley Works, New Britain, Conn.

CARTER TIME-SAVING TOOLS



MERGING OUR FORCE WITH THE FIGHTING FRONT!

OPERATING on war plastics 24 hours a day, we are rapidly merging our entire effort with that of the boys at the front. Doubtless, by the time you read this, our goal of EVERY WORKER BEHIND A SOLDIER will be reached.

In the heat of our war production — as a sort of "silver lining"— useful ideas are constantly suggesting themselves. Scarcely a war contract is completed that does not bring out some short cut, some improvement in tensile or compression strength, some new application that should be of lasting value to plastics users.

Like thousands of others, you are probably thinking ahead to your peace time production. If any of the knowledge our engineers have gleaned would stimulate your thinking, feel free to draw upon it. In the meantime, please

Send Us Your War Contracts

for estimate. To maintain a victory bent pace, new work must replace old — the "guns" must be kept firing. So, naturally, your requests are welcome and will receive prompt attention.

•

Waterbury Plastics

THE WATERBURY BUTTON CO.
WATERBURY, CONN., U. S. A.

WBCo

EST. 1812

that will not be mixed with the resin. For these reasons, it is better first to mix the resin and catalyst well, and then add the fillers. The batch should then be thoroughly mixed and all the lumps beaten out of the fillers (Figs. 5-9).

Excess plastic should always be poured (about 1/4 in. on large castings and 1/8 in. on the small ones) to allow for surfacing off the bubbles that will rise to the surface. Casting should be allowed to set outside the oven for at least 1/2 hr. before baking to allow the air bubbles to rise to the surface.

Here are a few "Don'ts" that are the results of experience and experiment in preparing molds and castings:

Don't lacquer a hot object.

Don't use aluminum lacquer to coat a mold.

Don't pour plastic into a mold when the lacquer is not dry.

Don't put a lacquered mold in the oven immediately after spraying.

Don't use shellac on molds.

Don't cast around metal inserts without immunizing.

Don't experiment with actual tools.

Don't mix the different types of lacquers or thinners.

Baking. The baking time depends upon the size of the castings. It also depends upon the type of mold used and the thickness of the material used in the making of the mold. The following table is to be used only as a guide and not as a strict rule. It is based on the actual baking time of the plastic and does not include the time necessary for the heat to penetrate the molds. The baking temperature is 175° F.

Castings up to 1 gal.	—2 hrs.
Castings 1 to 2 gals.	—3 hrs.
Castings 2 to 4 gals.	—3 1/2 hrs.
Castings 4 to 8 gals.	—4 hrs.
Castings 8 to 12 gals.	—6 hrs.
Castings 12 gals. up	—8 hrs.

If a casting is soft and pliable when it is taken from the mold, it is still green. It should be hard and completely cured when it is taken from the oven. If a casting is pulled green and put back into the oven to cure, it is likely to get soft, pull out of shape set in that position. *Be sure casting is cured.*

Experience with cast plastic tools

It should be understood here that plastics are not a cure-all and that one plastic cannot do all the jobs. Plastics have their limitations. Much depends on the tool itself and the work it has to do. Much thought has been given by Lockheed and Vega—the first to use cast resinoids for extensive tooling—to all classes of tools and even to individual tools within the classes. Designs for proposed plastic tools have been scrutinized closely even before the orders were written. Personnel has been trained, not only in the making of the tools themselves but also in determining their adaptability and choosing the various compounds for the different applications. Suggestions for handling the tools have been made to the men who use them.

Plastic advocates at Lockheed and Vega have been gratified with the reception given plastic tools, which seems due partially to the psychological effect of their attractive appearance. The men want to take care of them. Consequently, reworks due to breakage or misuse have been exceedingly small. The tools are popular also because of their light weight and ease of handling (Fig. 10). The research and development groups are continually investigating and testing better materials to do the same jobs, and new materials to do different jobs. The outlook is very bright. The industry can look ahead to stronger and tougher plastic materials—and to an increase in plane production.

Wired window protection

(*Continued from page 52*) sash, this flange gives a bearing surface which can be tacked securely to the wood, preferably by means of an automatic stapler (Fig. 2). Space between the edge of the cellulose acetate-wire laminate and the "V" section of the sash on the outside (or weather surface of the sash) can then be filled with putty to provide a permanent, weatherproof installation.

On a standard 4 or 6 light window, containing glazed units 10 in. by 12 in. or 10 in. by 14 in., each light can be firmly attached by eight staples, two to a side. The most satisfactory results are obtained where the formed plastic sections are restricted to an area not greater than 17 in. by 20 in., according to the manufacturer.

For the glazing of metal sash, a procedure is now being developed which will be announced shortly by the material supplier. It is anticipated that with the use of special types of putty, plus a modified type of clip now employed for holding standard window glass, it will be possible to install the plastic material in such sash.

Though slightly more expensive than window glass, the plastic laminate costs only half as much as safety glass, but the recency of its development accounts for the fact that it has not replaced window and safety glass completely in such installations.

Another manufacturer employs a 14-mesh wire screen for a similar laminated plastic glass, also for Navy use. Again the material is cellulose acetate sheet, and the new windows are said to permit the passage of ultraviolet rays and to keep the heat in (Fig. 3).

PHOTO, COURTESY CELANESE CELLULOID CORP.

3—Clarity of laminated plastic wire window pane is evident above as operator attaches laminate to frame

Applications

At the present time, both materials are confined to U. S. Navy use in war areas for such construction as demountable temporary housing, including troop quarters; buildings being made and shipped to various points; installations in buildings at navy yards, naval bases and shipyards working on Navy contracts. Potential uses for the material are in Army cantonments, camps, permanent forts, air fields, coast artillery and in vital industrial plants in potential air raid zones.

Credits—Material: Vuelite, by Monsanto Chemical Co.; Lumapane, by Celanese Celluloid Corp.

Weight of coating per sq. yd., oz.	Breaking strength 1 × 1 × 3 Grab method, pounds (minimum)		Adhesion tests, coating strapping seams pounds (minimum)	Tearing strength scale reading (minimum)		Hydrostatic test pounds (minimum)	Heat test softening point (minimum)	Cold test
	warp	filling		warp	filling			
5.0 max., 2.5 min.	45	32	Not less than 4 pounds	15	10	15	180° F. (no adhesion of surfaces)	Shall not crack at 0° F.

Table I

Right for rain

(**Continued from page 43**) may be Class "B" construction. Hems on the bottom of the coat, yoke and sleeves may be turned up 1/2 inch and stitched 3/8 inch without cementing.

D-4d. *Waterproofing of seams*—All joining seams shall be completely waterproof. Classes "A" and "B" seam constructions shall withstand without leaking a hydrostatic pressure of 50 cm. for 15 minutes; class "C" seam construction shall withstand a hydrostatic pressure of 15 lb. per square inch.

F. Methods of Sampling, Inspection and Tests

F-3a. *Hydrostatic test*—The coated fabric and finished seams shall be tested by insertion in a Mullen or Suter or similar testing machine having a circular opening 1.2 inches in diameter. To adapt the tester, the diaphragm is removed and water used as the liquid. The water level should be flush with the surface of the tester so that no air pocket is formed. Apply the pressure slowly and steadily to the face of the coated fabric at a rate of speed not exceeding one revolution per second. The pressure reading is taken at the first appearance of water through the fabric being tested.

F-3c. *Heat test*—Shall be made on the coated fabric and finished seams. A sample 2 × 4 inches shall be doubled, face to face, and placed between two glass plates, weighted with a one pound weight and heated for 30 minutes at 180° F., in a thermostatically controlled oven. The two surfaces shall show no evidence of adhesion or exudation when separated. Allow five minutes cooling on removal from the oven before making observation.

F-3d. *Volatile plasticizer test*—The coated fabric and finished seams shall be conditioned for 24 hours and a 3 × 3-inch sample cut out and weighed. The sample shall be placed in a circulating hot air oven and held for 5 hours at 105° C. plus or minus 2° C.; cooled and conditioned for 3 hours and again weighed. The loss in weight shall not exceed 5 percent, computed on the weight of coating and the heated sample shall show no appreciable change in pliability.

F-3e. *Resistance to low temperature*—The coated fabric and finished seams when subjected to a temperature of 0° F. for 60 minutes, and tested at that temperature by folding face outward and creasing sharply in both warp and filling direction, shall not show signs of cracking or flaking.

F-3f. *Weather test*—The coated fabric and finished seams, after exposure to the elements, unprotected for 30 days, shall show no appreciable change in color, pliability or strength, and shall not show signs of flaking, peeling or cracking.

F-3g. *Aging test*—The coating on the fabric and finished seams shall show no signs of becoming stiff and brittle, nor soft and tacky when exposed to an atmosphere of oxygen at 300 pounds pressure per square inch, and temperature of 158° F., for 8 days.

F-3h. *Water spray test*—This test consists of exposing both the coated fabric and finished seams to a spray of water, drying and noting any change in flexibility due to leaching of the compound. The face of the samples, held in a frame, shall be exposed to the spray at an angle of 45° so that the center of the specimen is 6 inches directly below the nozzle. Water shall be allowed to spray on the specimen for 24 hours. The sample is then dried and flexibility noted. There shall be no appreciable loss in pliability.

F-3i. *Adhesion test*—The adhesion shall be measured as the average pull in pounds required to separate the two plies of the material over a distance of 3 inches. The testing machine and its operation shall be as specified in Section VI, Paragraph 3, Federal Specification CCC-T-191, except that the jaws shall be not less than 2 inches wide. The adhesion shall be not less than 4 pounds.

F-3i (1) *Coating*—Two samples of the coated fabric 2 × 6 inches are cut out in the warp direction and the coated faces cemented together by a suitable cement or solvent and then placed between two glass or metal plates 4" × 6" × 1/16" of approximate equal weight, and weighted with a 1 kg. weight and held in an oven at 105–110° C. for 1 hour. The sample is allowed to cool for 1 hour and the edges of the two plies separated and placed in the jaws of the testing machine.

F-3i (2) *Strapped seams*—The pull required for separating the strapping from the fabric shall be not less than 4 pounds.

F-3i (3) *Cemented seams*—The seams shall first be separated for a distance of 3 inches and inserted in the jaws of the testing machine. The pull required for separating the fully cemented seam lapped 3/4 inch, longitudinally shall be not less than 4 pounds.

Credits for raincoats described—Material: Vinylite; Koroseal

Bearing strength

(**Continued from page 73**)

The plywoods were definitely inferior to the reinforced plastics in bearing strength. In nearly all cases, heating improved the bearing strength of the specimens and soaking in water decreased their bearing strength, as compared to that observed for the specimens conditioned at room temperature and a relative humidity of 55 percent.

The proposed load versus deformation (4 percent of bearing pin diameter) test gave much more satisfactory results than did the proposed load versus permanent set (0.2 percent of bearing pin diameter) test and, in addition, was easier to perform. For these two reasons the former test is more desirable.

This project was carried out in the Materials Testing Laboratory of the University of Kansas under the supervision of Professor Earl D. Hay, Head of the Department of Mechanical Engineering. The problem was suggested by Dr. G. M. Kline, National Bureau of Standards, and the materials supplied directly by him were obtained through the courtesy of the following firms:

Bakelite Corporation—Molded Macerated-Fabric-Filled Phenolic Compound, BM-199 Tan.

Continental-Diamond Fibre Co.—Laminated-Canvas Phenolic Plastic, Grade C Natural.

Resinous Products and Chemical Co.—Birch plywoods bonded at 300° F. with Tego Resin Film No. 2.

Fairlead guide blocks

(*Continued from page 63*) to these newly developed plastic guides is the fact that they can be assembled and disassembled without unthreading the cable. Replacements can therefore be made quickly and easily with a minimum of wear and tear on the complete control assembly. A slight pressure of the studs will serve to disjoin the unit. To assemble, the plastic parts are placed over the cable, aligned and slid together. The plastic assembly is then fitted between the metal parts and screwed in place (Fig. 4; see Fig. 5 for construction).

These new fairlead guide blocks have been introduced in two types, similar in construction except that one uses an aluminum base. Both accommodate cables up to $^{3}/_{16}$ in. in diameter. The difference is that where stress limitations permit a $^{29}/_{32}$-in. diameter hole in the structure, a fairlead without the aluminum base, and with the plastic guide resting in a $^{29}/_{32}$-in. diameter hole in the structure (as shown in Fig. 6) may be used. The elimination of the aluminum base results in a guide block that is lighter in weight and lower in cost, but equally efficient for the specific application outlined.

Figures 7–8 show a typical structure which does not allow a $^{29}/_{32}$-in. diameter hole for fairlead housing. There are numerous other places heavily loaded which would require a heavy reinforcing gusset if a $^{29}/_{32}$-in. diameter hole were used, while a $^{9}/_{16}$-in. diameter hole would be satisfactory.

The plastic guides for these fairleads are produced from multiple-cavity molds. Both types of fairleads are furnished in complete sets including type Z sheet metal screws, compactly packaged in small collapsible boxes which include simple instructions for assembly printed on the outside.

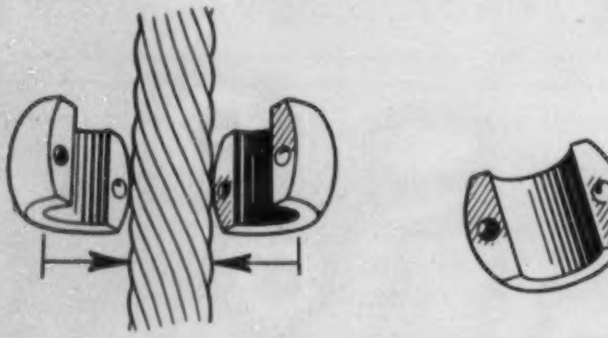
One manufacturer of a Navy fighter plane uses a fairlead similar to those described, except that the guide is a two-piece graphitized phenolic plastic structure (Fig. 9–11).

Special inserts are provided in the mold to make 15 different hole diameters in the guide to accommodate a variety of cables and control rods which range from $^{1}/_{16}$ in. to $^{1}/_{2}$ in. in diameter.

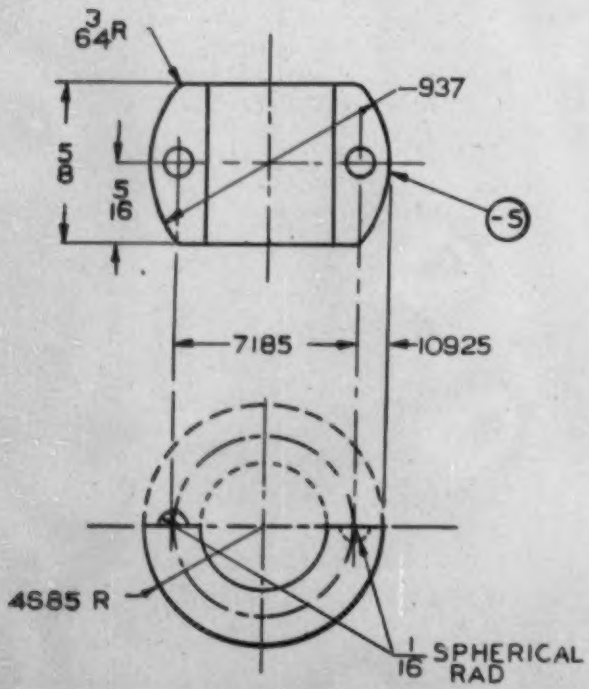
The plastic is impregnated with natural graphite so that the guide is self-lubricating, and these fairleads are used not only for control cables but also as control rod bearings. Although these fairleads, too, are adjustable to any angle of the cable they do not have the rotating eccentric plug which forms an important segment of the two other models discussed.

All of the fairleads described have already been used on test planes by several companies, and the combination of plastic materials with the ingenuity of the design is reported to have effected a considerable saving in assembly time and labor, as well as to have turned out an efficient item of service in many structures which require control cables or rod bearings to function properly.

10—*Two-piece graphitized phenolic fairlead guide is easily assembled around control cable and is adjustable to any angle.* **11**—*Cross sectional construction of this type unit*



10



11

Credits—Materials: Bakelite, Insurok (graphitized phenolic). Molded by General Industries Co. and Richardson Co., respectively, for Tinnerman Products, Inc.

Molding plastic-plywood

(*Continued from page 49*) by Frank Russell, and Floyd Odlum, Atlas Corp. head, took an interest. The Vidal Research Corp. and the Aircraft Research Corp. were formed, one to create, the other to build. These two companies were later merged and now conduct extensive research and development operations, the results being made available to the licensees.

Some of the company's early trials are typical of those of all new ventures. One of the first contracts received was for a basic trainer for the Army. The first wing, built along orthodox lines of construction, was sent to Wright Field, Ohio, for testing. The Vidal engineers held their breaths when the wing was piled high with bags of shot to simulate the stresses of flying. The wing broke. "A lousy job," commented one of the officers in charge, and it probably was, says the inventor. He studied the geodetic design of a British fuselage, something that had never been used in wing making, rebuilt his wing along these lines. It withstood every test.

The Navy ordered floats for a training plane, which were made and sent to Norfolk for rough landing tests. The floats were fitted under the ship, and a test pilot took it aloft. It was a windy day and Hampton Roads was choppy. When the plane hit the bumpy water on its return, the float buckled and the ship went down in forty feet. "A lousy job," was the Navy's comment, and again it probably was, says Vidal, although he still believes the trouble was in the strut and not in his float. In any event, the plane was under water and the Navy not exactly pleased. These were the early days. Since then Vidal and his licensees have furnished parts for

bombers, pursuit ships, trainers, etc., and have some of the best known names in aviation on their long list of customers.

The first entire ship built by Vidal was the little Summit,[2] for the Summit plant, supplier of planes for private use. Everything except the motor, landing gear, etc., was "cooked" together, and some very interesting developments occurred. It was a sleek job, powered with a 75-hp. motor as are other small planes. Because of the smoothness and rigidity of its skin, the new plane's speed was reported as showing an increase of 20 miles per hour through elimination of wind drag and vibration. This was in 1938, and the war upset the company's plans to go forward with this new plane. The first two-motored plane molded by the Vidal method was the Langely,[3] which created much enthusiasm among aviation men.

The builders of big bombers have not yet been convinced that this type of material is as good as metal for entire ship construction, although many of them have installed autoclaves and are playing with the idea. The answer, however, seems to have come from Canada. An Anson bomber fuselage engineered by Vidal, which is larger than that of the famous Lockheed-Hudson, has been tested for ten months by Canadian pilots and negotiations are now under way for the placing of a large contract, we are told. Word comes from the north that the pilots scramble for this particular ship on training flights, not only because it is faster, but also because it does not have the vibration of the metal planes and is warmer in winter, the laminated wood not being a conductor of heat.

The Canadian Government offered Vidal a contract for sample parts for the Anson bomber, which he passed on to a licensee, Universal Molded Products Corp. An assembly line was set up, engineers and workmen borrowed from the licensor, and the work of delivery is going ahead—in fact many thousand bomber parts have already been shipped.

Another group, Allied Aviation Corp., is also handling large contracts for airplane parts, working night and day and enlarging their facilities. One of their projects is the construction of a transport glider, a great bird-like structure capable of carrying twelve men and their complete equipment. The forms for this ship, containing more than a carload of lumber, lie on the platforms in the great hangar-shaped building like whales that have been washed up on the shore. Their dimensions are still a military secret. To form the fuselage of this ship requires a tank 9 ft. high and about 60 ft. long. Because it was impossible to build one, a fumigator used by the Port of New York Authority for fumigating imported bales of cotton was secured and is now in operation. To give some idea of the simplicity of other equipment used by this concern and other licensees: a battery of pressure tanks formerly used in one of the tire factories is used by the company for making smaller articles, such as bomber flaps and a new type of ski for Army purposes.[4]

As Vidal sees the picture, the process has many possibilities. He visualizes lifeboats, speedboats, sailboats and steamship superstructures as a natural field for this process and material. A lifeboat, for example, which ordinarily weighs about 1500 lb., when built by the bag-molding process weighs about 500 lb., yet is sufficiently strong and more easily handled. A lifeboat was built at the Universal plant in the same tank used for cooking a whole fuselage. United States Plywood

[2] See MODERN PLASTICS, July 1940, "Molded airplanes for defense," p. 25.
[3] See MODERN PLASTICS, October 1941, "Twin-motored plastic-plywood plane," p. 51.
[4] See MODERN PLASTICS, May 1942, "'Working' skis for U. S. troops," p. 50.

Corp., another licensee, has molded about 1500 pleasure boats and is building several hundred special boats for the Government.

In describing boats made by the new method, Vidal says: "Do you know that during the thousands of years since boat building became an art not a new basic idea has been created? They still bend planing around ribs just as they did when the ancient Phoenicians built their galleys. With this method a boat is built without ribs. It comes out of the tank a completely formed shell ready for paint."

The application of low-pressure molding methods to plastic materials has already given to the fighting forces such products as the Army helmet liner (see MODERN PLASTICS, May 1942, p. 35) and skis for Army troops (*ibid.*, p. 50). It is reasonable to expect that, as increased demands are made upon American industry for matériel, this technique will be responsible for putting a larger percentage of plastics into war production. And in the postwar years, when more time and thought can be given to industrial research, low-pressure molding methods should contribute to home, farm and factory many a useful article made of plastic material.

Woodpulp plastic products

(Continued from page 54) however, has produced pieces that are about twice as strong, and so thicknesses may be reduced accordingly. Tendency toward warpage is present, but not to an excessive degree, and can be controlled. Tolerances are poor, because cast bronze molds lack the accuracy of machined steel. An estimated tolerance of plus or minus .02 may be assumed.

The material lends itself to certain types of machining and not to others. Drilling, punching of prepared thin sections and assembly with self-threading screws are feasible. Nailing is not practical. As yet, threads have not been successfully molded, but this is a possibility with large size threads. In such items as bottle caps, however, ornamental units may be molded which can be made to accommodate threaded inserts, either by molding the insert in or by subsequent gluing.

A perfume package with a fluted base indicates savings made possible by the use of this material. This base originally was made of cast metal. When the piece was reproduced in woodpulp plastic, the perfume manufacturer for whom it was molded saved 36 lb. per gross in shipping weight due to the lightness of the material as compared to the castings.

The 12-in. molding (Fig. 3) was used as a housing for a movable display. An item like this one could probably not be reproduced in any other type of material except at extreme cost because of the small quantity involved. This order was for 1000 pieces. The irregular shape made the job out of the question for wood. A steel mold for reproducing the piece in a synthetic resin plastic would have cost as much as the assembled job could bring to the manufacturer. The mold for fabricating the piece in woodpulp plastic cost only $250.

The advantages and disadvantages of wood-plastic materials of this type vary in direct ratio with the size and quantity of pieces to be molded. Where large quantities of small pieces are to be made, the low material cost is not sufficient to overcome the advantage of automatic injection molding. However, should these same small pieces be required in comparatively small quantities, the low cost of the cast molds would be strongly in their favor. The larger the moldings become, the more advantageous becomes the low cost of this molding material.

The people's pump

(Continued from page 39)

Two plastic gland, or packing, rings seal the metal plunger in the barrel at the handle, and are designed to hold the packing within the packing gland. These rings are $^{11}/_{32}$ in. deep, have a 1-in. outside diameter and a $^1/_8$-in. wall section. The tops of the rings are flat and incorporate a slight radius on the outside edge. The bottoms are sharp on the outside and beveled to the sharp inside opening.

The plastic nozzle is molded in two parts which are acetoned together after the permanent installation of a metal slide and spring. The outlet end of the nozzle is $1^3/_{16}$ in. long with a $^5/_8$-in. outside diameter. The wall thickness at the point of discharge is $^1/_{16}$ in. and an inside taper increases it to $^1/_8$ in. at its opposite end. On opposite sides of this heavier end are two lugs, $^1/_2$ in. high and $^5/_{16}$ in. wide, with round cored holes which reduce the weight of the part and act as additional bearing surfaces for the metal slide. The hose connection section of the nozzle is $2^1/_{16}$ in. long, $1^1/_4$ in. of which is the connection member, and the remainder molded to assemble with the outlet section to form the hoze nozzle. Two $^1/_8$-in. diameter holes are punched rather close together in the metal slide. When the spring is pressed, one of these holes aligns with the inside opening in the nozzle to give a steady, continuous stream of water. Releasing the spring brings the metal web between the holes across the nozzle opening to split the stream, which rebounds from the nozzle walls in a full spray.

Assembled stirrup pump will be equipped with 10 ft. of hose, for which samples of plastic material are now being tested. It should be reasonably fireproof, have good aging qualities

PHOTO, COURTESY FORMED STEEL TUBE INSTITUTE

The fact that the WPB would not permit the use of reclaimed rubber in the hose has brought several plastic materials to the attention of the Engineering Division of the Office of Civilian Defense, and one type of plastic hose covered with woven fabric has already proved satisfactory under test. Specifications for this hose will not be released until other

types of plastic hose have been tested. The inside diameter of the hose is to be $^3/_8$ in. and each pump will be equipped with 10 feet. Hose for the stirrup pump should be reasonably fireproof, have good aging qualities, be strong and durable, and withstand continuous static pressures of at least 100 lb. per square inch. Samples of plastic material may be submitted to George Angell, Chief, Fire Prevention Sect., Bureau of Industry Operations, WPB, Room 4070, Railroad Retirement Bldg., Washington, D. C., for consideration, testing and approval. Plans and specifications for the pump are available to bona fide manufacturers if they will apply to Mr. Angell at the same address.

Credits—Material: Tenite II. Pump designed by John D'Arcey, WPB. Molded by American Molded Products Co.

Converting for Uncle Sam

(***Continued from page 59***) employed girls as press operators, our production has jumped 50 percent." Neatly uniformed in coveralls, these girls take real pride in turning out crystal-clear lenses for Uncle Sam. They know they are doing their share of an essential job and doing it well.

Each shift has a foreman who attends to press maintenance, makes necessary adjustments from time to time and supervises the ever-moving production in the molding room. After inspection, lenses are carefully fitted into slots in cleverly designed cartons similar to those used for eggs. No packing material is used and no protection provided except that given by the walls of the slots. All that remains to be done is to ship the cartons to various companies where the gas masks are finally assembled.

In spite of continuous operation of the molds, not a single one has had to be replaced. One or two cavities have gone bad, but not beyond salvage; and because of careful press maintenance and pressure adjustment, the molds do not seem to wear enough to vary the lenses.

Scrap from molding the lenses adds up to sizable poundage. Waste gates, sprues and runners can be ground and used over again, of course—but not for lenses. These must be made with fresh, clean compound all the time. The company uses scrap material for commercial products and small subordnance jobs.

A large portion goes into small cone-shaped holders used to package tapering spiral springs that fit into incendiary bombs. Time was when shipping these delicate little springs from the manufacturer who made them to the point where they were assembled into bombs caused no end of trouble. The springs tangled together disastrously and it took precious time and infinite patience to separate them for use. Now each spring is fitted into a cone-shaped cellulose acetate holder. Holders, with springs inside, are nested in long strings for convenient shipment to assembly points. The holders are removed as the springs are used, then returned to the spring maker's factory to be used over again.

The little cone spring holders come from the injection press at the rate of 48 to each shot, (Fig. 5) which makes it possible to keep up with the increasing quantity required as war production grows.

Busy as they are with defense work, Allied still finds time to get out products of less warlike nature, among them a safety goggle used in many industrial factories to protect vital eyesight of workers, which is made up of two large lenses and molded frames held together with an adjustable rubber cord over the bridge of the nose (see MODERN PLASTICS, March 1942, p. 92).

London Letter

Although the details are secret, there is no doubt that the welding of plastics is receiving a great deal of attention in Great Britain today. Considerable strides have been made in the welding of methyl methacrylate resin for use as aeronautical components and the results are claimed to be greatly superior to those previously obtained by other methods, such as annealing, cementing, etc. The joint effected by welding is claimed to be stronger than the original material, just as transparent and much quicker and easier to produce. The increase in speed of joining up parts by the welding process enables assembly work in aircraft factories to be speeded up appreciably. It is hoped that further practical details will soon become available for publication, but meanwhile this brief note is well in advance of the technical press in this country.

More information has come to hand about the growth of the vinyl plastic section of the British plastics industry. The plant put up by the Imperial Chemical Industries has been greatly enlarged during the last twelve months and today is able to supply all needs without leaning on imports from the States. Five varieties of polyvinyl chloride are now being produced and their chief applications to date are sleevings in the aircraft industry. While on this subject of plastics for aeronautical purposes, it is of interest to point out that Great Britain is using far more weight of plastics in the construction of operational planes than the Nazis, although at the outset of hostilities this state of affairs was reversed. Polyvinyl acetal resins available in this country in several different forms, particularly sheets from $^{5}/_{1000}$ in. upward, and in granular form for extrusion and solutions for adhesive purposes. It is an extremely strong thermoplastic and retains its mechanical strength at low temperatures. It is especially recommended where strong rigid moldings in thin sections, together with freedom from warping and shrinkage on exposure are required. The specific gravity varies between 1.20 to 1.40; tensile strength 8000 to 11,000 lb. per sq. in.; softening range, 75 to 85° C.; modulus of elasticity 4.0×10^{5}; Brinnell hardness 12 to 16; water absorption 1.4 to 2.0 percent and burning rate slow.

A good deal of interest is evident in ethyl cellulose, now available in this country in small amounts. This plastic is offered to the trade in sheets 54 in. × 24 in., thicknesses from $^{5}/_{1000}$ in. upward, and also in extruded rods and tubes and all usual colors. It is recommended for all purposes for which straight cellulose acetate can be used, with the advantages of non-brittleness at temperatures down to −50° C., and excellent resistance to weak acids and to alkalis of all strengths. Practically all this material is imported from the United States.

The polyethylene resin Polythene or Alkathene (I. C. I. product) is a material which, after a somewhat sluggish start, is now coming into its own for all kinds of cable work where pure rubber was formerly employed. The electrical properties of natural rubber are far excelled by Polythene, and by suitable orientation its physical properties can be very considerably improved. The plant producing this most valuable alternative to rubber is being greatly increased to meet the new demands. (*Mailed June 2, 1942, by Mrs. John S. Trevor.*)

Sorry!

★ THE SOUTH BEND LATHE WORKS, SOUTH BEND, Ind., has called to our attention the omission, on page 84 of our May issue, of the fact that there is a charge of 25 cents for the company's booklet, *How to Run a Lathe*, to cover printing cost.

★ IN THE JUNE ISSUE, PAGE 48, THE TEMPERATURE range for the Tinnerman Aircraft Wiring Clamps was incorrectly stated. The figures should have read "from −30 to +176 deg. F."

CLASSIFIED

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and colors for our quotation—Reply Box 508, Modern Plastics.

WANTED: PLASTIC SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

FOR SALE: Stokes Rotary Tablet Machine, Type DD, 500 to 700 Tablets per minute, ⅝" to 1 $\frac{1}{16}$" Tablets. 15" x 15" Watson-Stillman Transforming Press with Pushback and Ejectors. Reply Box 512, Modern Plastics.

FOR SALE: 1—W. S. Hydro-Pneumatic Accumulator 2500 PSI, 8 gal., with IR m.d. air compressor; 1—W. S. 15" x 18" Hydraulic Press, 9" dia. ram, 4" posts; 6—Semi-automatic Hydraulic Molding Presses, from 15" x 18" to 32" x 36" platen surface, rams 9" dia. to 20" dia. ram, all with hydraulic pullbacks and slotted heads for die attachments; 2—W. S. Hand Pumps; Royale ½ Perfection Tuber; Adamson 6" Tuber; 7—W. & P. Mixers; Colton 2B Single Punch Tablet Machine; Dry Mixers, Pulverizers, Grinders, etc. Send for complete list. Reply Box 446, Modern Plastics.

WANTED: Hydraulic Presses, Preform Machine and Mixer, Stainless Steel or Nickel Kettles, Vacuum Pan. No Dealers. Reply Box 275, Modern Plastics.

FOR SALE: 400 ton horiz. Hydraulic extrusion press. Hydraulic scrap baler, 80 ton, 6½" ram, 90" stroke, 5000 lbs. per sq. in. W. & P. mixer, size 15. 75 ft. link belt conveyor, 36" wide. Large stocks of Hydraulic presses, pumps & accumulators, preform machines, rotary cutters, mixers, grinders, pulverizers, tumbling barrels, gas boilers, etc. Send for Bulletins #156 and #138, and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

SALES REPRESENTATIVE covering the States of Ohio, West Va. and Western Penna., located at Pittsburgh desires to represent a reputable manufacturer of plastics on a commission basis. Reply Box 575, Modern Plastics.

AN EASTERN ORGANIZATION is interested in obtaining a man as production engineer for Compression Molding. Qualifications should include experience and knowledge of manufacturing, estimating costs and the construction of new molds. Reply Box 576, Modern Plastics.

WANTED: Following presses—300 ton, 160 ton, 80 ton compression and toggle presses. Must be in good condition. Write full details. Reply Box 577, Modern Plastics.

WANTED: Chemical engineer or chemist with experience in development and manufacture of molding compositions, preferably in the urea-furfural branch. State salary expected and details of education and past experience. Reply Box 578, Modern Plastics.

RESEARCH CHEMIST WANTED: Excellent opportunity for a chemist who has had several years experience in actual formulation of thermosetting and thermoplastic resins for laminated products and also in paints and coatings. One having had experience with paper products preferred but not essential. Should be creative and capable of going ahead with assigned work. Correspondence held strictly confidential. Reply Box 580, Modern Plastics.

WANTED: Research Chemist with working knowledge of production of synthetic laminated sheets. Diversified experience with thermoplastic and thermosetting materials would be helpful. Splendid opportunity. Correspondence confidential. Reply Box 581, Modern Plastics.

CRESYLIC ACID for sale. Limited supply available under government allocations. Inquire William D. Neuberg Company, 420 Lexington Avenue, New York City. Telephone LE 2-3324.

WANTED: Practical plastic man with executive ability to operate new custom shop in Middle West. Must have production, fabricating and knowledge of machinery and dies used in the plastic industry. State years experience, age, and salary expected. Splendid opportunity for proper person. Reply Box 582, Modern Plastics.

WANTED: Hydraulic presses 50, 100, and 200 ton capacity, standard types, general molding presses, for Bakelite and similar plastics. Write full descriptions and prices. Reply Box 583, Modern Plastics.

WANTED TO PURCHASE: Reed-Prentice injection molding machine 4 and 6 ounce in good condition. Give full details. Reply Box 584, Modern Plastics.

WANTED: Plastic Sales Engineer to create new ideas and develop new fields in the plastic industry. Must have thorough technical knowledge of plastics. State experience and salary expected. Excellent opportunity with old established plastic firm. All applications will be treated confidentially. Reply Box 585, Modern Plastics.

FOR SALE: (1) Isomma automatic injection moulding machine, 40 gram capacity, A1 condition, and (1) De Mattia scrap grinder 200 lb. per hour capacity, A1 condition. Supreme Engraving Co., Inc., 315 West 39th St., N. Y. C.

WANTED: THERMOPLASTIC MATERIALS of all descriptions—Scrap and Virgin. Please furnish full particulars and send small representative samples. It will pay you to consult us regarding custom grinding, demagnetizing, cleaning and grading of your materials. All inquiries will receive prompt and careful attention. H. Muehlstein & Co., Inc., 122 East 42nd Street, New York, N. Y.

WANTED: Chemical engineer or man with thorough experience in technique and production to take charge of injection molding department, equipped to make large articles in plastics. Must understand die construction and be thoroughly familiar with molding technique. Give experience, references and salary expected in first letter. Reply Box 590, Modern Plastics.

CHEMIST WANTED for development work on plastic formulations for molding. Write giving full particulars including photograph and draft classification. Midwest concern. Reply Box 591, Modern Plastics.

WANTED

Man familiar with plastics and plastic molding, with General Sales Experience including contacts with the users of Premiums and Specialties. Some engineering background also desirable. Position with established, well-rated plastic concern, offering good future. In reply, give full details of draft status, education, experience, and references. Reply Box 586, Modern Plastics.

FOR SALE: 1—3-S-27-12 oz. Lester Injection Molding Press with 8 oz. cylinder, complete with 30 H.P. motor and automatic starter. Installed, but never used. Reply Box 587, Modern Plastics.

FOR SALE: One #336 Strain Analyzer Polariscope made by Simpson Foundry & Engineering Company. Only slightly used. In good condition. Reply Box 588, Modern Plastics.

FOR SALE: One unused extrusion conveyor 30′ long. Complete with endless white neoprene faced belt, air cooling duct adjustable front section and infinitely variable take off speeds. Also one new Royal oil circulating unit of 9KW capacity. Reply Box 589, Modern Plastics.

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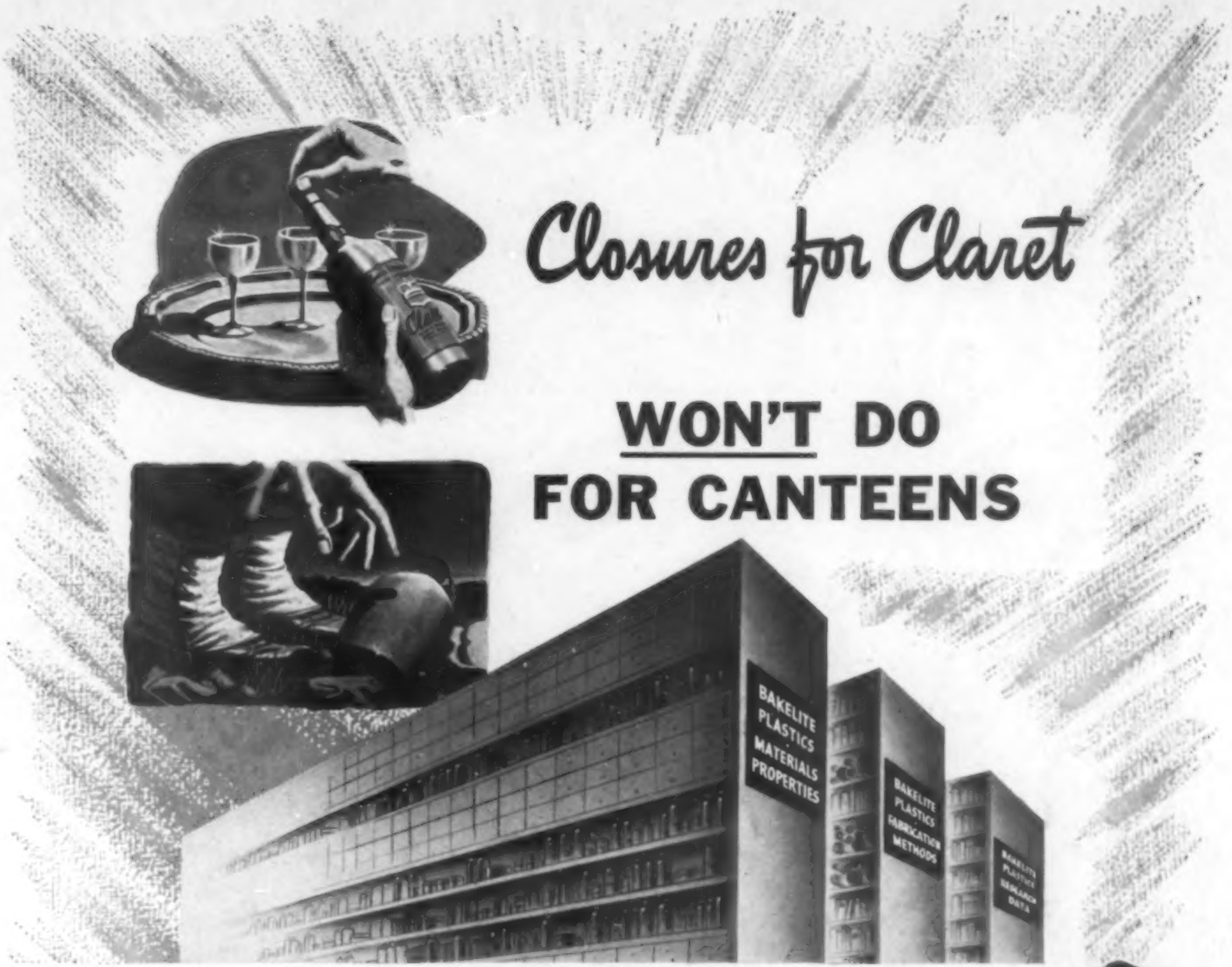

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IF YOU are using plastics for the first time, or switching from one type of plastic to another, the contrast between an ordinary plastic bottle cap and the Army canteen cap typifies the basic problems you may face . . . problems calling for careful consideration of plastics selection, design, and fabricating technique.

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